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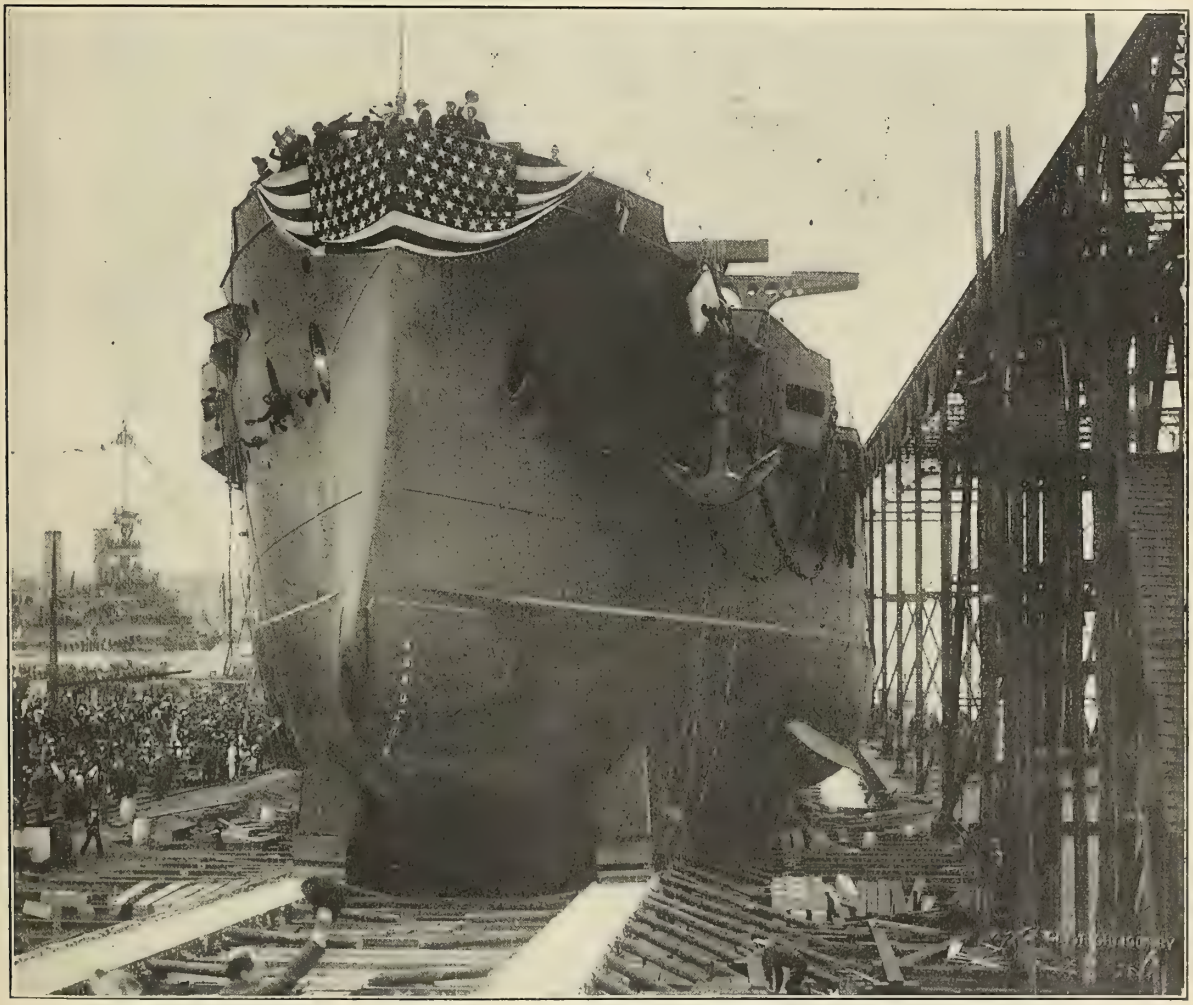
UNITED STATES BATTLESHIP CONNECTICUT LAUNCHED.

When the battleship *Connecticut* was floated in the East river from the Brooklyn Navy Yard on September 29 there was a very great feeling of relief on the part of those connected with the launching, as previous to the event three distinct attempts had been discovered to wreck this ship. The particulars were not given out until after the launch, and then Rear Admiral Frederick Rogers, commandant of the yard, stated that a person, or persons, evidently connected with the working force, had on two occasions bored holes in the hull plating, and the day before the launch a long spike was discovered on the under water portion of the ways. Any one of these three dastardly deeds might have caused serious damage to the ship; the first two by filling the hull with water and the last by ripping open the bottom plating.



THE BATTLESHIP CONNECTICUT SLIDING DOWN THE WAYS, AT THE BROOKLYN NAVY YARD, ON SEPTEMBER 29.

[Photograph, Copyright, 1904, by Hammett.]

A guard of marines had been placed about the battleship for several days previous to the launching, but the offenders were not detected. The commandant has issued a letter to the employees of the yard reviewing the incident and calling upon them to assist in detecting and convicting the guilty party.

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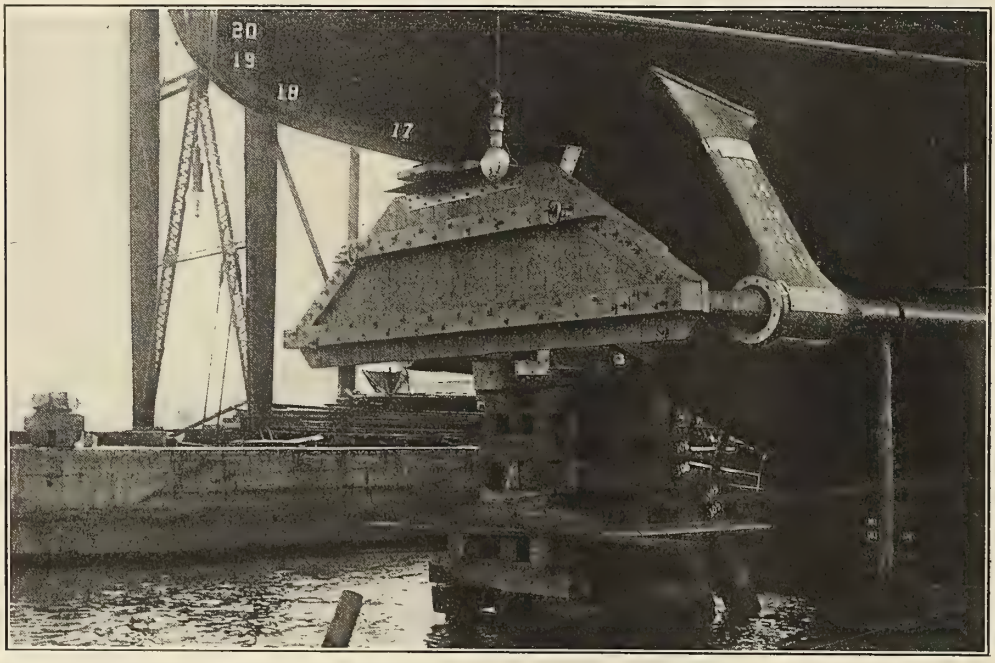
Another unusual incident at this launch was that after the sponsor had failed to break the bottle of champagne, to be used in the christening, a sailor on deck pulled up the bottle by the cord with which it was, as is the custom, attached to the prow, and broke it after the vessel had started down the ways. The engraving on the first page was made from a photograph taken at this moment. A description and the principal dimensions of the *Connecticut* were given in the October number of Marine Engineering.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 105 sail and steam vessels of 14,699 gross tons built in the United States and officially numbered during the month of September. The largest steel steam vessel included in these figures is the *Wilkesbarre* of 1,197 gross tons, built at Wilmington, Del.



BREAKWATER AT THE STERN OF THE CONNECTICUT TO BRING HER TO REST AFTER LAUNCHING.

VIEW IN THE BROOKLYN NAVY YARD, SHOWING THE CONNECTICUT IN THE DISTANCE.

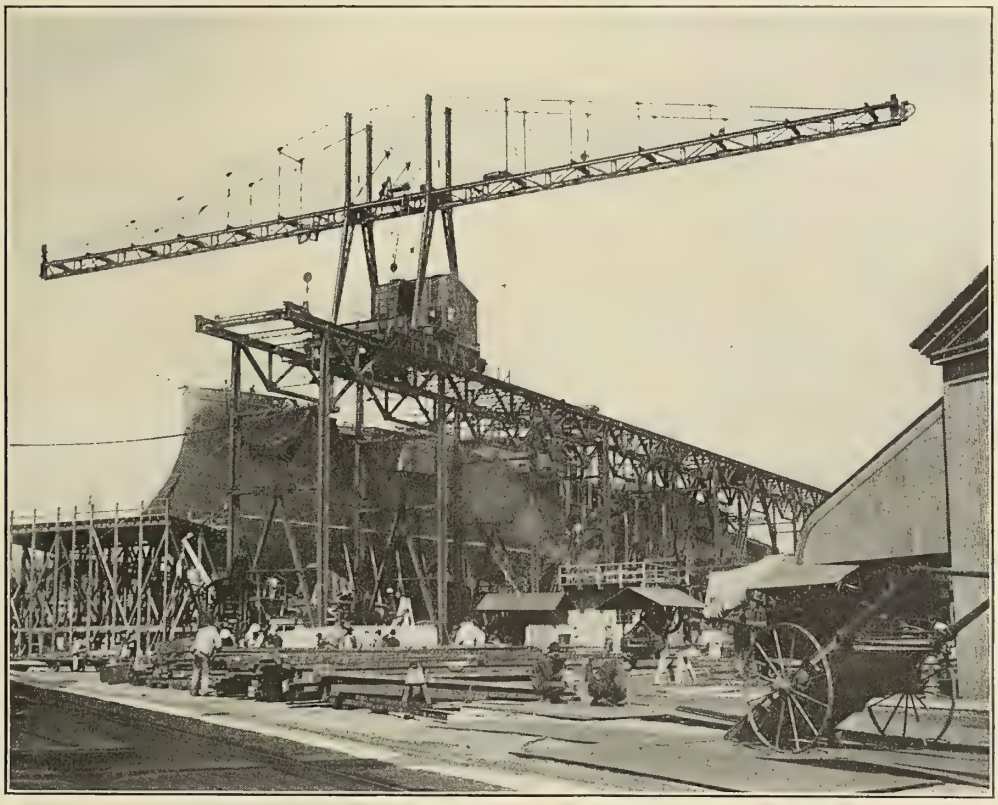
[Photographs by F. T. Hastings.]

TRIPLE SCREW PROPULSION.

BY REAR-ADMIRAL GEORGE W. MELVILLE, U. S. N., RETIRED.

The lessons of the war in the far east are more than interesting to the engineering profession, particularly so to that which relates to ship construction and marine engineering.

The order of our President is explicit that no officer of the army or navy of the United States shall enter into any discussion of the relative merits of either nation or course of action of either their fleets or armies. It is not only just that the President should issue such an order but that the order should be implicitly obeyed. But this does not bar us from learning lessons for ourselves that may be applied to the benefit of our navy in our new constructions. The first lesson we have learned is the necessity for a high powered fleet of fast ships, either battleships or armored cruisers, with great coal endurance, and perfect protection to the propelling power and steering gear of this class of ships.



BATTLESHIP CONNECTICUT AND NEW GANTRY CRANE, AT BROOKLYN NAVY YARD.

The lesson of the loss of the *Rurick*, the Russian armor-clad ship, the consequent delay and scattering of the Russian fleet at that time, the forced return of some of the ships of that fleet to Port Arthur and subsequent abortive attempt to join Russia's Vladivostock and Port Arthur fleets into one strong fighting unit, may be traced to the fact that the *Rurick's* steering gear or rudder and part of her propelling power were disabled at the same time.

As the report comes to us, it is said that a shell from one of the Japanese ships exploded under the stern of the *Rurick*, disabling her rudder or steering gear, and at the same time disabling one of her twin screws. Now, had this ship been a three-screw ship, as nearly all of Russia's modern ships are now fitted, as well as those of Germany and France, it can readily be seen that had her center screw and one of her wing screws remained intact, the ship could have proceeded with at least two-thirds power, and in an emergency even greater power could have been crowded through the two remaining engines and screws, so that not only the *Rurick* might have escaped but possibly the whole fleet. As it was, because of the delay of more than one hour, when the Russian fleet was trying to blanket and protect the damaged ship, the time thus lost if skillfully used, even in a running fight, might have saved the fleet to Russia. Whether this reasoning would apply in all cases and under all conditions is a question that it is impossible to decide offhand, for so many contingencies arise in battle that no fixed rule can be made to fit them all.

Accompanying this prelude to my subject, I take pleasure in stating the following reasons why the three-screw system should be applied to naval vessels of more than 3,000 tons, bearing in mind that it is not a new or novel system, but that it is in almost universal use in the navies of Russia, Germany, and France; Great Britain and the United States alone neglecting this great military advantage in time of war and the greatest source of economy in coal in time of peace or on blockade.

Not only for men-of-war alone, but for the high powered transatlantic liners, the three-screw system would prove most advantageous in case of accident to either engine or rudder, and as the increase of engineer

force in engine or fire rooms amounts to but 6 per cent. of the number of men, it is a small amount to pay for the increased security in mail-passenger service. In the United States protected cruisers *Columbia* and *Minneapolis* the additional force employed for each ship in the engine room, for oilers, was but nine men, or three on each watch for three watches when the ship was under way. Now that we are having numerous three-screwed turbine ships projected and being built, and many more projected with four shafts and propellers, three-screwed ships will cease to be a novelty and the traveling public on our high powered transatlantic liners will demand the three-screw system as they now do the twin-screw, and avoid a single-screw ship. After years of service the machinery of the *Columbia* and *Minneapolis* is reported in as good condition as when built, and the fleet engineer of the training squadron reports to the navy department that the ships are able to make the speed they did on their trial trips, which speaks well for their design, builders, and the care and attention they have had from the engineer force since they were first commissioned. In fact, the adoption of the three-screw system for ship propulsion will act as rudder and propeller if rudder or steering gear and any one of the three screws or engines is disabled.

The following are a few of the reasons in favor of the three-screw system. I have also stated some of the disadvantages that might arise from the system:

The triple screw is no novelty in naval construction. It has been used in Russia, France, and Germany. Russia possesses eleven naval ships fitted with triple-screw engines, and these ships are of late design. France has ten battleships and nineteen cruisers of this type, and the latest armored cruiser launched, *Dupetit-Thouars,* is fitted with triple screws. In the case of Germany the decision has been practically reached, after competitive trial of the twin and triple-screw systems, to adopt the triple-screw design exclusively in all future war ships of the home fleet. She has already 19 such vessels.

England alone, of the strong naval powers, continues to design twin screws for her most powerful vessels. In doing this she is only pursuing that same conservative policy which makes her refuse to drive her turrets electrically, and which impels her to shun superimposed gun turrets. If this conservatism upon the part of England, as respects the question of triple screws, is based upon sound engineering design, then what reason have we for maintaining that the British Admiralty is not equally justified in its decision to adhere to the hydraulic working of turrets, and in its determination to reject, for all classes of ships, the superimposed arrangement for heavy guns. Concerning the conservatism of the British Admiralty, *Marine Rundschau,* a leading German periodical, in its issue of March, 1901, says:

"It must be pointed out how inordinately conservative they (the English) are for holding on to old methods, and how they object to anything new in their navy. It was only after the French had built iron clads, and had successfully tried them, that the English decided to change their 'wooden walls' to iron ones; and they were many years behind other navies in adopting breech-loading rifles."

In matters pertaining to the navel personnel, it has been the practice of Great Britain to follow rather than to lead our service. In matters pertaining to the material, she has always assumed the conservative attitude, maintaining the position that as the greatest sea power she could rest well content with existing conditions, and that such construction as submarine and commerce destroyers are the expedients of weaker powers. Therefore, with respect to the best distribution of motive power, as well as with respect to the question of the arrangement and distribution of battery, the British Admiralty is regarded rather as observers than opponents of American precedents.

In adopting the triple-screw system there will not be introduced either any innovation or discredited design of motive power. The demand for this character of installation is made rather to prevent us falling behind our competitors in naval construction than in the desire to lead our rivals. The practical reasons for thus distributing the power in armored vessels may be embraced in three distinctive groups.

ECONOMIC ADVANTAGES.

Where judgment has been exercised in utilizing the power, marked economy has been secured by the use of triple screws. The economy of this installation is so well recognized by the Germans that the matter is no longer in dispute. It would be remarkable if there were not economic advantages. There must be a saving of coal where the distribution of power is of such nature that only the amount of machinery need be put in operation which can be run at economical speed.

The official trials of the *Columbia* and *Minneapolis,* when compared with those of the *New York* and *Olympia,* prove conclusively that there was a decided economy of propulsion. Probably no data were ever obtained with more care than in the official trials of the four ships named. There was an ample corps of trained observers. The system of observations was the result of experience after many official trials. The indicators had been most carefully calibrated by the same experts in all cases, and the apparent pressures were corrected for the errors of the instrument. There can be absolutely no doubt of the accuracy of the data.

Some of the special economical advantages are the following:

(1) In time of war, or emergency, the ordinary cruising can be maintained by the side engines while the center engine is run at just sufficient speed to clear its propeller. Where there is a necessity for an economical expenditure of coal, and an equal necessity for being in readiness to move quickly, the center engine can be run slowly while the side engines can just turn over. In either of the above cases the load on the engine that is just turning over is only that due to friction, and therefore the coal expenditure is exceedingly small. Such operation of triple-screw engines was actually done on the *Minneapolis* during the late war. When operating the engines in this manner it is only necessary to open all the throttles to secure a maximum speed. Such a condition or readiness at a slight cost of fuel can only be secured with triple screws.

(2) At full power the economy will be equal to or greater than with twin screws. At reduced speeds the economy will be much greater, thus increasing the steaming radius and keeping the vessel longer on blockade or other important duty.

(3) The economy is secured by more efficient propulsion. It is also attained by the more efficient use of steam in the engine, due to decreased condensation following the increased piston speed.

(4) The economy of the triple-screw system has been shown by actual experiments and experiences in our service. These results have been verified by the experience of the French and the Germans. Russia has not conducted comparative tests, but the general belief exists in that service that the triple-screw system is the most economical.

The economic superiority of the triple-screw design is now practically recognized by every nation that has possessed ships of the two types. Such judgment has been founded upon experience and experiments. A design of motive power which secured a reduction in the consumption of coal is of great military advantage. "Coal, or the want of it, is the life or death of a fleet." Its consumption must be reduced on the modern war ship, and the great trend of marine engineering research is in the direction of such economy. To continue building twin-screw engines in high-powered naval vessels is to be one engine behind in the race for naval supremacy.

STRUCTURAL ADVANTAGES.

In addition to the economic advantages resulting from the design, there are structural reasons why the system should be adopted. The following are a few of the resulting advantages:

(1) The engines can be made lighter, cheaper, and simpler.

(2) The subdivision of water-tight compartments is more efficiently secured.

(3) The nearer the screw to the center of the vessel the more efficient it is. The screw need not extend so far beyond the lines of the hull. The screw is less liable to disablement from ramming any floating obstructions.

(4) Shorter lengths of shafting can be used. The use of struts can be obviated under certain conditions.

(5) Smaller engine parts can be used. This is a marked military advantage, since it will not only reduce the cost of repairs, but permit the repairs to be made more rapidly as well as by a greater number of engine repair shops.

(6) The vibration is decreased. This advantage is of great importance, since it not only adds to the endurance and efficiency of the machinery, but contributes to the comfort of the crew, and passengers, if a passenger ship.

(7) Triple screws permit the installation of additional auxiliaries. The auxiliaries are the weak links in a modern battleship, and by the disablement of a single one a set of propelling engines can be thrown out of use. Where three sets of auxiliaries are installed, it would be but seldom that two sets of engines could not be kept in operation. In fact, two auxiliaries of any one description could be so forced that it might not be necessary to stop working any of the propelling engines if an auxiliary was disabled.

(8) More latitude is allowable in the design of machinery. Smaller and more efficient propellers can be designed, the piston speed increased, the foundations made lighter, the working parts smaller, and all permit greater ease of repairs.

Structural reasons first impelled the marine engine designer to suggest the triple-screw engines. The advantages were so apparent that the installation was secured. The resulting structural and engineering benefits were very great, and yet it is but fair to recount the disadvantages which the system entails.

The following are the principal structural disadvantages:

(a) Greater number of parts. In all high-powered naval vessels fitted with twin screws there are two sets of engines coupled on to each shaft. Six cylinders with their attendant working parts are required for each set of machinery, so that as a matter of fact there are more working parts with the twin-screw system of the same power.

(b) Greater number of valves and pipes; but these fittings are smaller, and therefore more easily overhauled and repaired.

(c) Greater number of auxiliaries. In the cross security of being able to use any auxiliary on any propelling engine this ought to be a marked advantage.

(d) Increased engine room force. The total increase in the fire and engine room force is about 6 per cent.

(e) Intricacy of piping. Additional piping of course is required, but no man competent to run high-powered machinery would regard the additional lengths of piping as producing complication, and in all cases the piping is smaller in proportion to the unit used.

(f) The engine space requires more room lengthwise. Space is utilized in the after part of the vessel, however, that could be only used as store rooms for spare gear.

The structural advantages so far exceed the disadvantages that from an engineering standpoint there can be no justification henceforth for the use of twin screws in large powered vessels. It must be understood that by the adoption of the triple-screw system we use three sets of engines instead of four. The *New York* and the *Brooklyn* have two sets of engines coupled to each of the twin-screw shafts for economy in fuel at low cruising speed. The experience of the *Brooklyn* at Santiago shows that where two sets of engines are coupled to the same shaft, the vessel would practically go out of action if the attempt were made to couple the shafts in times of emergency. These are sufficient structural reasons alone to justify the adoption of the system.

TACTICAL ADVANTAGES.

In addition to the economical and structural reasons for installing triple screws, there are tactical advantages to be secured. When the German Admiralty began giving consideration to this subject her experts did not look for other than economical and structural advantages. In fact, it was believed that investigation would show that tactical reasons would prevent the further use of triple screws in German war ships. With the thoroughness that characterizes German research, extended experiments were planned for the determination of this question. The *Friedrich III.*, fitted with triple screws, was pitted against the twin-screw ships *Brandenburg* and *Sachsen*. All manner of tactical evolutions were attempted. To the surprise of the German experts the *Friedrich III.*, fitted with triple screws, showed a marked tactical superiority over her rivals.

These experiments caused increased attention to be given to the tactical reasons for adopting the triple-screw

system. It was found that the ships fitted with such installations steered best, and that the art of steering was more easily acquired by the sailors, as the ships took no rank sheer, as is found to be the case with vessels carrying twin or single screws.

As confirmatory of the *Friedrich III.-Sachsen* experiments the following particulars are given: The first squadron of German battleships, comprising three vessels of the *Imperial* type, *Emperor William the Great, Emperor William the Second,* and *Emperor Barbarossa,* fitted with triple screws, made two long cruises during the past summer. It is reported of them that they could be more easily steered and manœuvred, a new proof of the advantages of the triple screw over the double propelling system of the *Brandenburg* type.

The remarkable fact is now presented of the German experts declaring that it is principally for tactical reasons, and not by reason of the structural and economical advantages, that Germany has settled upon the policy of using triple screws for all large-powered ships in home waters. The following are the principal tactical advantages:

(1) Increased assurance of working the entire machinery. This is of special importance in battle or in time of emergency, when maximum power is required for a short period. At Santiago the *Brooklyn* could not use her maximum power because only the after engines of each shaft could be used, the forward engines being uncoupled.

(2) Decreased liability of imperilling the motive and manœuvring power of the vessel. This advantage arises from being able to install the screws near the center of the vessel, thus decreasing the chances of the propellers being hit by a floating obstruction.

(3) The steering or manœuvring qualities of the ship are not so likely to be interfered with in triple as in double screws, since it is not likely that more than one engine will be disabled, as in the case of the Russian battleship *Rurick.*

(4) A tactical advantage, not hitherto shown, is better control when under stern board. An experiment with the *Columbia* when in a narrow channel went to show that she could readily be steered when going astern by carefully handling the engines and disregarding the helm, the helm being amidships. This we know cannot be done with either single or twin-screw vessels.

(5) A helm angle from 6 1-2 to 10 degrees is required to keep a twin screw on her course when only one screw is used. No such angle would be required when one of the three screws is disabled.

(6) Greater safety of machinery due to better distribution of power.

(7) In case the rudder is carried away or disabled the triple-screw ship can be more easily handled, since the wing screws can be used for guiding and the center one for propelling the vessel—again the *Rurick.*

(8) All the tactical advantages secured by twin-screw vessels are maintained; additional ones are attainable.

The *Brandenburg-Sachsen* experiment showed that evolutions could be performed with triple screws that could not be done with twin screws. The March number of the *Marine Rundshau* gives detailed description of buoy experiments which could only be performed by ships fitted with triple screws.

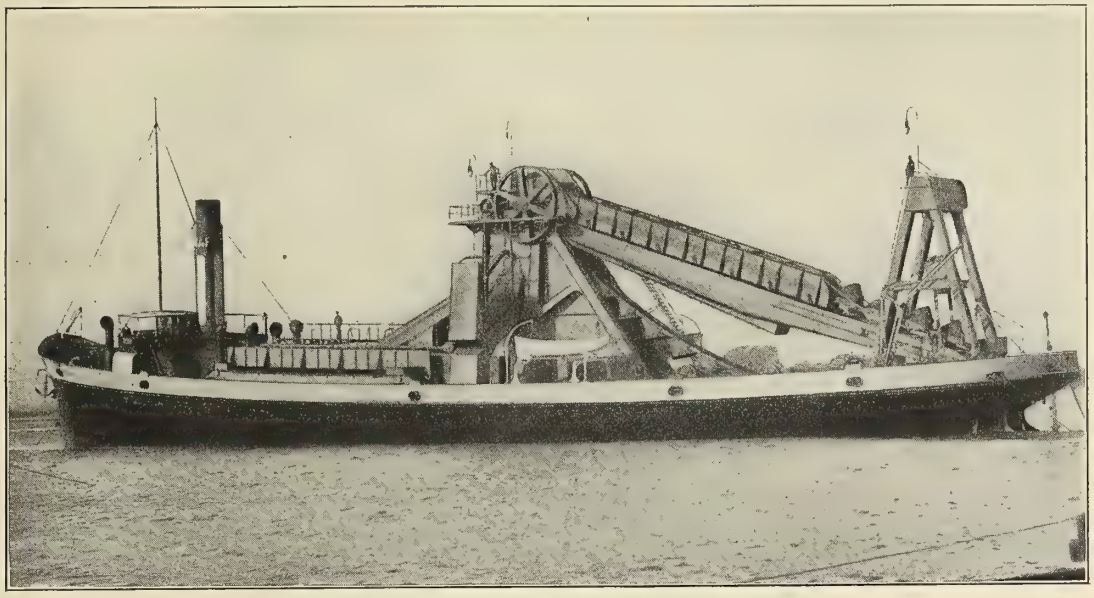
Since the triple-screw design permits smaller engines to be used, there is a tactical and military advantage in such construction. Smaller engines are cheaper, lighter, simpler, more easily managed, and more easily overhauled. This may be of great significance, now that we are finding such difficulty in securing trained men for the engine rooms of our war ships. In view, therefore, of the economical advantages, as shown upon official trials; of structural advantages, as recognized by marine engineers, designers, and builders, and of tactical advantages, as determined by careful experimental investigation and research, there should be no hesitancy in using the system.

The distribution of the motive power is no less important than the distribution and arrangement of the battery. It is just as logical to arrange the battery of the new war ships in the same manner as was done a decade ago as it is to continue the custom of installing a twin-screw arrangement of motive power that is not in accord with existing needs.

For the past five years I have continuously and consistently urged the installation of triple screws for high-powered ships. My only regret now is that I was not more insistent in urging the adoption of the system. Under several occasions I determined to present a minority report against twin-screw engine propulsion for high-powered ships. Such official protests were not made because the assurance was given that there were grave tactical objections to its introduction, and that data to support the contention would be furnished. With each succeeding year progressive evidence has been adduced that the system is not only in accordance with sound engineering practice, but it supplies a tactical need of the future battleship.

The triple-screw system for high-powered naval vessels is no longer either an innovation or an experiment—it is a military necessity. The continued installation of twin screws in such vessels is not only against progressive engine design, but fails to meet the military and tactical requirements of the future. If such practice continues our naval prestige will be lessened. To defer adopting triple screws is marked retrogression. The distribution of power by triple screws is simply keeping pace with the best naval construction of Europe. Any action of a contrary nature is simply discrediting the ships in process of design. It is, therefore, imperative that this system be adopted unless the facts herein set forth can be controverted.

Annapolis School the Model.—Captain William H. Bronson, superintendent of the Naval Academy at Annapolis, recently returned from a tour of investigation of the naval educational methods of Europe. He stated that it was gratifying to find that England, which had been ridiculing the American system of naval education for many years, and had finally condemned the establishing of an academy, was now establishing naval schools virtually modeled after the academy. One school had been opened at Osborn and another would be opened at Dartmouth next year. In Germany a naval school, which Prince Henry stated was to be a small Annapolis, will be opened next year.



SELF-PROPELLED DREDGE FOR BUCKET AND SUCTION DREDGING.

COMBINED BUCKET AND SUCTION DREDGE CONSTRUCTED FOR THE GOVERNMENT OF URUGUAY.

A longitudinal section of the interesting self-propelled bucket and suction dredge to be described in this article, is shown by Fig. 1, while Fig. 8 represents it as ready for sea.

This boat has been lately built by Messrs. A. F. Smulders, of Rotterdam, for the harbor works now in progress at Montevideo, on behalf of the government of Uruguay. The special feature is the arrangement by which dredging may be carried on at will through the same well, either with a chain of buckets or by means of a suction pipe. When using buckets, the dredge can work to a depth of from 13.1 feet to 32.8 feet below the surface of the water, with the ladder in its ordinary position, while by altering the upper bearing of this to a special support, the depth reached can be extended to 42.7 feet below the water line. The transmission is so arranged that every minute 16 buckets will pass the top pinion. The minimum excavation demanded by the contract is 654 cubic yards per hour, when dredging at a depth of 26.3 feet.

The boat is so arranged that it can deliver the spoil either into hopper barges placed alongside, or into its own well, which has a capacity of 1,046 cubic yards. This is best seen in Figs. 3 and 7. The freeboard of the barges when unladen is 9.8 feet, and they are to be moored 6.6 feet away from the dredge when receiving their load. When carrying its own spoil the dredge was required to draw not more than 14 feet, and to be capable of steaming out to sea for unloading. When arranged for suction dredging, the machine works at depths of from 13.1 feet to 32.8 feet, and when dredging at depths of 26.3 feet it fills its well of above-named capacity in 40 minutes. When laden the speed in proceeding to sea was required to be not less than 7 knots, and the engines were also required not to consume more than 2.2 pounds of coal per I. H. P. per hour. The dredge has been built under the survey of the Bureau Veritas, and was awarded the highest classification. When finished, it proceeded to Montevideo under its own steam.

The results obtained on the official trials, made on behalf of the Uruguay government on the Meuse (Dutch river), during a period of fifteen days, are as follows:

	Conditions of contract	Actual results
Dredging by bucket, cu. yds. per hour.....	654	850
Suction dredging, " "	1,570	2,350
Speed, knots	7	8.2
Fuel consumption, lbs. per I. H. P. per hour...	2.20	2.09

The hull is built entirely of Siemens-Martin steel, and is 241 feet long by 41 feet wide, by 17 feet 3 inches depth of hold. The hopper has a capacity of 1,250 tons, and is 50 feet long by 33.8 feet wide at the top, and 23 feet wide below. Fully laden, and carrying 50 tons of fuel in the bunkers and 5 tons of water in the boilers, the draft is 14 feet. The hull is provided with the necessary accommodations for the engineer, the first and second dredging master, the chief mechanical engineer and his assistants, while the crew's quarters are provided forward as shown on the plans.

There are two engines of the horizontal compound type, placed nearly amidships—Figs. 1 and 3—which can drive at will either the centrifugal pumps of the suction installation, the dredging chain, or the two screw propellers. The two engines together develop 1,000 I. H. P. They are supplied with steam by two ordinary return-tube boilers, placed forward and built of steel for a working pressure of 113.8 pounds per square inch. The two boilers together have a heating surface of 3,444 square feet. Fig. 6 gives a section through the stokehold. The steam auxiliaries comprise a dynamo engine, centrifugal circulating pump, two Worthington boiler feed pumps, and eight double-cylinder steam winches used in manœuvring the craft.

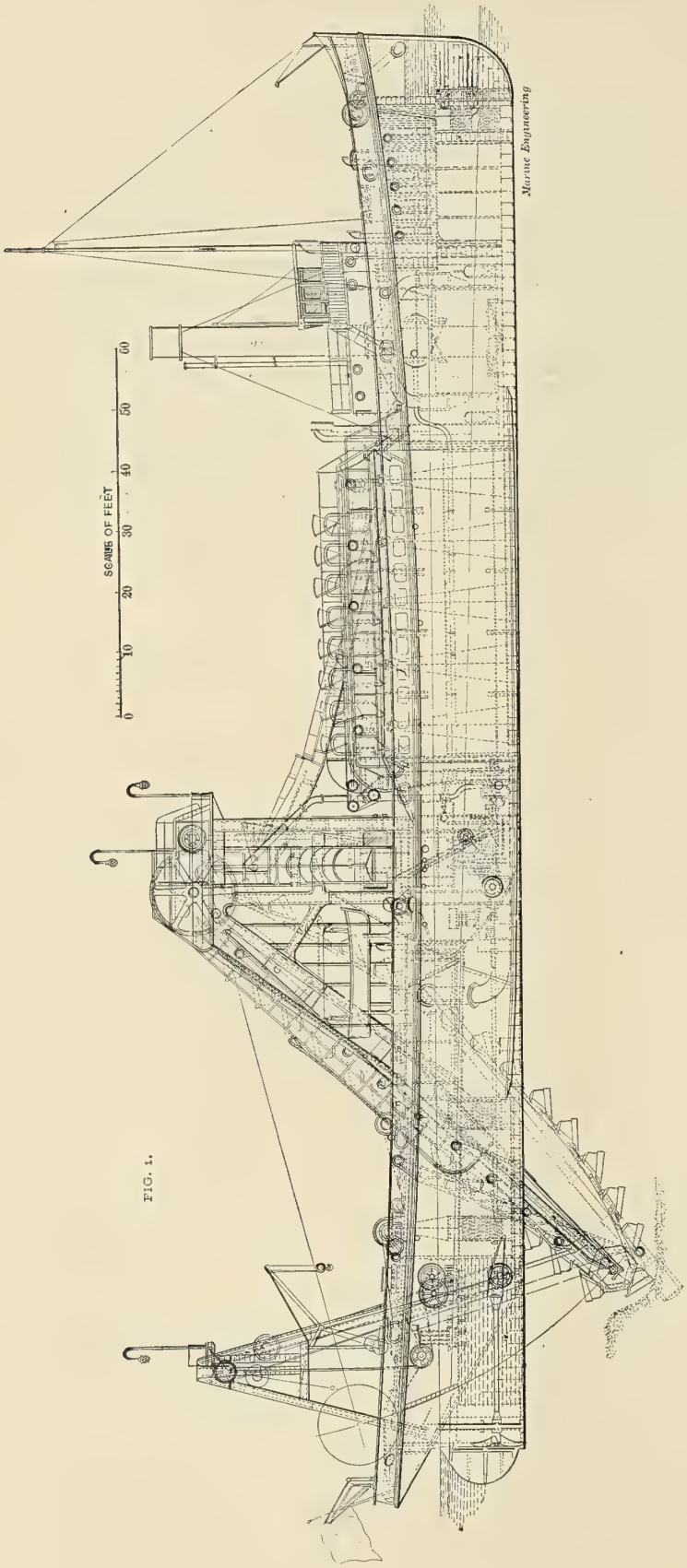


FIG. 1.

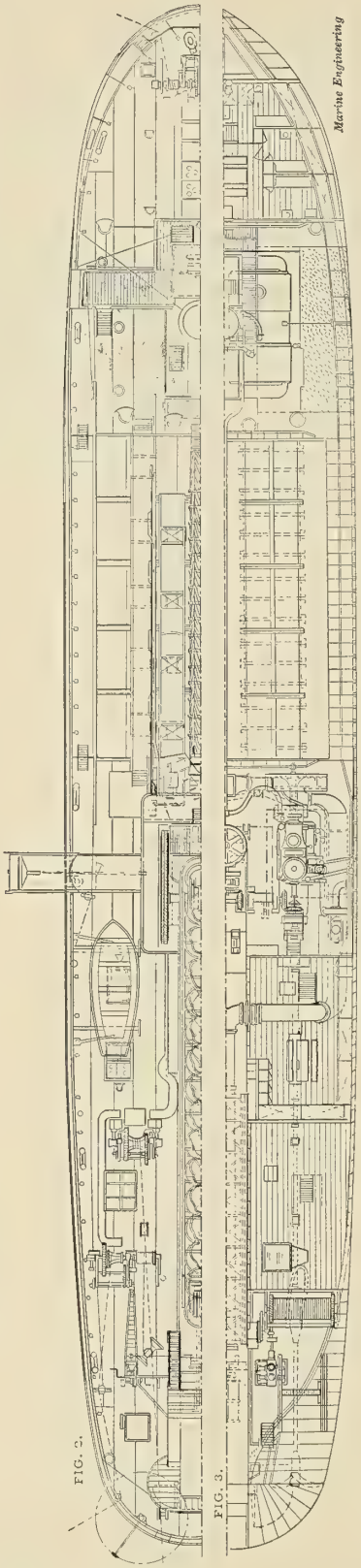


FIG. 2.

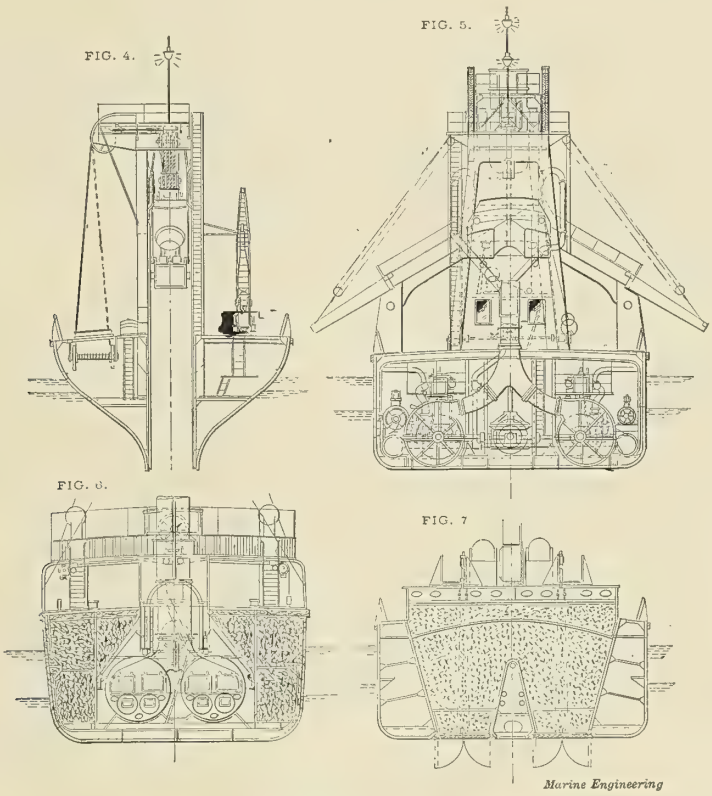
FIG. 3.

INBOARD PROFILE AND DECK PLANS OF URUGUAY DREDGE.

The buckets, which have a capacity of about 28 cubic feet, are of eliptical form, the body being of steel plate, sides, back, and lips of cast steel. They are 32 in number. The links are alternately steel castings of double T-section and steel plates; they are provided with removable bushings of Hadfield's manganese special steel, which can be readily replaced after wear. The bolts are also of the same steel, and have square heads to prevent turning save in the long bushes.

The transmission gear is so fitted to the main engines that either engine may be used for driving the chain, or for running the centrifugal suction pump. It is also possible to use one engine for driving both screws, while the other runs one of the centrifugal pumps. In the latter case, one of the screws is driven by means of gearing. The centrifugals are driven direct from the engine, but the dredging chain is driven through steel spur and bevel-gearing—see Figs. 2 and 5—by means of friction clutches, which in case of an excessive load slip on the chain and thus prevent breakage. The centrifugal pumps, which are designed for a minimum speed of 150 revolutions per minute, are driven direct through claw couplings on the crank shafting. The pumps are built up of steel plates and angles, with renewable wearing plates of steel fitted inside the casings. The impellors have four arms, also fitted with renewable wearing plates, and all parts may be readily inspected.

The framing carrying the upper pinion for the dredging chain is removable above deck level. The forward legs are riveted to the well sides, and are supported by heavy floors on the bottom at each side of the well. The rear legs rest on the deck, which is stiffened below by a strong beam running across the hull. The total distance from the bottom of the columns to the top of the pinion framing is 53.3 feet. The ladder frame, constructed in an extra-strong manner of plates and angles, is a built-up beam 88.6 feet long, which permits dredging to be done in depths up to 32.8 feet of water, as previously stated, without shifting the upper support of the ladder. The upper pinion is of square section, cast in a single piece out of white iron. The lower pinion is hexagonal and is a steel casting. The suction pipe may be stowed above the water level when the dredge is fully laden. The discharge pipe from the pumps, which is provided with sluice openings corresponding to each section of the hopper, is of rectangular section, and runs along almost the whole length of the hopper.



SECTIONS OF A COMBINED BUCKET AND SUCTION DREDGE.

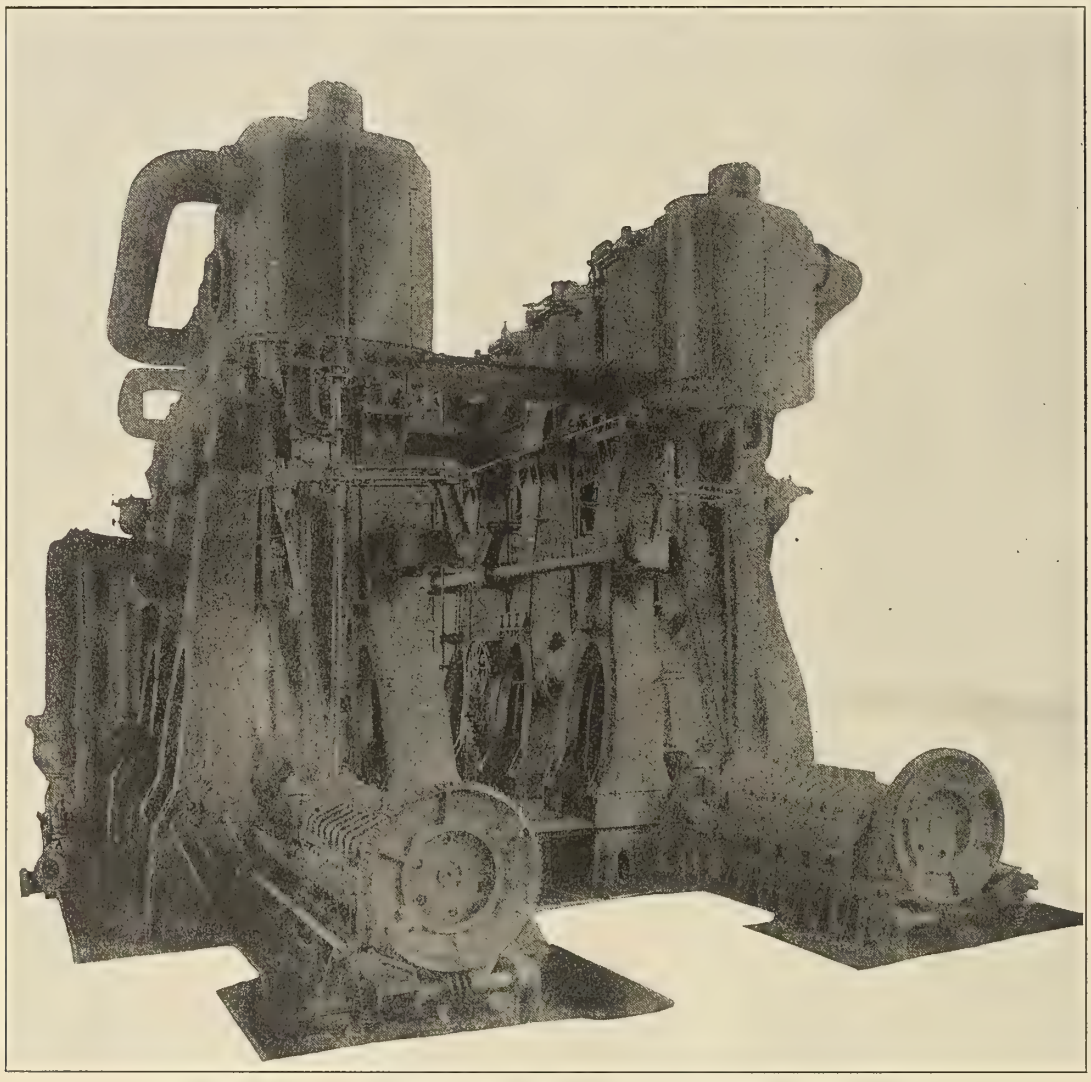
The deck of the boat is lighted electrically by means of three 1,000 candle-power arc lamps, and in addition there are incandescent lamps in cabins, engine rooms and stokehold. The navigating bridge is placed directly forward of the funnel, and is fitted with steam-steering gear, engine telegraphs, etc. A single formast is fitted as shown. Two life boats with mast, oars, and rudder are swung from davits, and rest on supports above the deck, so as to be out of the way.

Japanese Twin Screw Steamship Aki-Maru.

As evidence of the rapid strides made in Japanese shipbuilding, the new steamer *Aki-Maru,* here illustrated, bears conclusive proof. This vessel was built for Messrs. Nippon Yusen Kaisha by the Mitsu Bishi Dockyard & Engine Works, Nagasaki. The ship is a twin-screw, 15-knot, freight and passenger vessel, for the transpacific trade. She is built with poop and forecastle, and midship deckhouse in which all the first cabin accommodations are placed. The third cabin is placed under the poop deck and in addition the aft end of main deck is arranged to be fitted with berths for steerage. The sailors' quarters are in the forecastle, while the firemen are on the main deck forward.

A double bottom extends the entire length of the ship betwen collision bulkheads. There are three large cargo hatches leading to the forward holds, hatches Nos. 1 and 2 being worked from the foremast and by two steam winches each, and hatch No. 3 from two steel derrick posts, also serving as ventilators. A large cross bunker is at the forward end of fire room, and there are small pocket bunkers on each side of forward end of engine room. A fresh-water tank extends from top of thrust-shaft recess to main deck; above this is refrigerating space. Part of the No. 4 hold is built as a deep tank. The capacity of this tank is 490 tons; the capacity of the water bottom 1,177 tons, that of the forward and aft peak tanks, 130 tons, or a total of 1,797 tons of ballast, which will increase the vessel's draft when light 2 feet 5 inches.

The vessel is fitted with twin-screw triple expansion engines, which are shown in the accompanying engraving, and the cylinders are 20, 33 1-2 and 56 inches diameter by 48 inches stroke. Steam at 200 pounds pressure is supplied by two single-end and two double-end boilers. For other data see card on page 526.

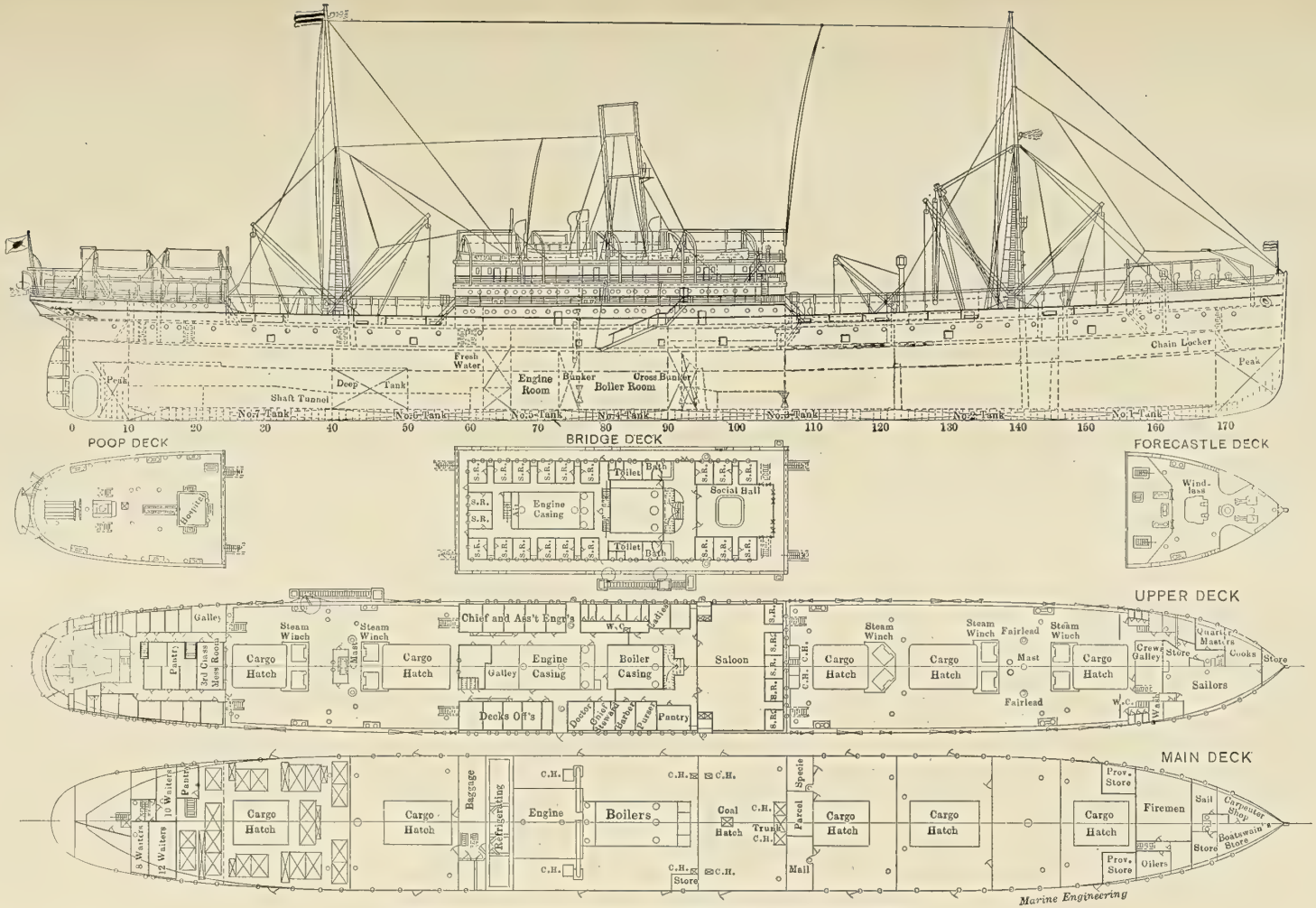


TWIN SCREW, TRIPLE EXPANSION ENGINES FOR THE JAPANESE STEAMSHIP AKI-MARU.

The Sale of the Union Iron Works.

The sale of the Union Iron Works, September 26, 1904, to the Reorganization Committee of the U. S. Shipbuilding Company for $1,700,000, marks an epoch in the shipbuilding and engineering business of the Pacific coast.

This plant was founded in 1849 by Peter Donohue; later it became H. J. Booth & Company, and still later,



ELEVATION DECK PLANS OF THE JAPANESE STEAMSHIP AKI-MARU.

Prescott, Scott & Company. During these days, Mr. Irving M. Scott became a managing owner in the firm, and from this time until his death, in 1903, the history of the Union Iron Works was one of progress and growth. From a small blacksmith ship and engine factory in the center of the city, Mr. Scott, in 1883, moved the plant to the Potrero water front in order to take up shipbuilding. Shortly before Mr. Scott's death, and before the shipyard was taken over by the United States Shipbuilding Company, there was at practically the same time the following marine work in progress at the works:

For the Hawaiian & American line, three freighters building, *Californian, Arizonan, Alaskan.* For the U. S. navy, cruisers *California, South Dakota* and *Milwaukee;* battleship *Ohio;* monitor *Wyoming;* cruiser *Tacoma;* torpedo boats *Perry, Preble, Paul Jones;* submarines *Pike* and *Grampus;* two ships having oil burning system installed; one oil tank steamer built; one pontoon dock fate for Russia and one for Hunter's Point, and much milling work. At present they are building three cruisers, besides numerous repair jobs.

NAVAL ARCHITECTURE.*

BY SIR WILLIAM H. WHITE,[1] K. C. B., F. R. S.

At the request of the committee this paper has been prepared in order to place before the International Engineering Congress a summarized statement of the development of naval architecture in Great Britain during the last ten years. Within the limits of space assigned, it is only possible to indicate the principal advances made in methods of ship construction and propulsion; some points of interest and practical importance have necessarily been omitted.

BRITISH WAR SHIP BUILDING IN 1894.

It will be convenient to note at the outset the condition prevailing in British shipbuilding in 1894. In many respects that date is notable. In regard to war ships, it marked the practical completion of the great programme of construction which had been embodied in the Naval Defence Act, 1889. Under that act provision had been made for adding 70 ships of various classes to the navy, including 10 battleships, 9 first-class cruisers, 29 second-class cruisers, 4 third-class cruisers, and 18 torpedo gunboats. The original estimated cost of these vessels and their armaments was 21 1-2 millions sterling. In certain classes modifications were made and dimensions increased as the programme was executed, in order to obtain greater fighting and sea-keeping capabilities. About a million sterling was thus added to the cost; the fact being recognized when the changes were authorized. The actual outlay on the 70 ships was about 22 3-4 millions sterling; about four-fifths of that sum being expended on hulls, armor, machinery, and gun mountings, and one-fifth on guns, torpedoes, and ammunition. Taking into account the fact that the vessels were of novel types, of unprecedented speed, and armed with the first quick-firing guns of large caliber, this was a remarkably close approximation between estimate and expenditure. Thanks to the splendid resources of the United Kingdom in ship yards, engine factories, and steel works, the programme was practically completed within the five years contemplated, although that period was marked by abnormal activity in mercantile shipbuilding, about 5 1-2 millions of tons of new ships having been launched in the years 1889-93.

Having been responsible for the designs of these seventy ships, as well as for the estimates of total cost and distribution of expenditure over the quinquennial period, and having also been charged with the direction of the work of construction and the supervision of the manufacture of armor and other materials, it is naturally a matter of satisfaction to record the successful accomplishment of this undertaking, which was pronounced to be impracticable by many authorities. But it is pleasant to add that this result was chiefly due to the magnificent shipbuilding, engineering, and metallurgical establishments of Great Britain, established and maintained by private enterprise. Even for the 38 ships built in government dock yards, private firms provided all the materials, the machinery, the armor, and a large proportion of the armament, the contribution of the dock yards being confined to the labor—representing an aggregate cost of about £3,750,000—expended in the combination of materials and mechanisms furnished by private industry.

This was the first great programme of construction for the Royal Navy carried out on definite and systematic lines. It stands alone in having been published in its entirety before the work began. Since 1894 there have been other programmes, some of them of greater magnitude. These programmes have been dealt with, officially, as elaborately as the Naval Defence Programme, and have been carried through with equal success. In these cases, however, there has not been previous publication of the full programme, but only of such parts as were included in current naval estimates. Of the two systems, it would appear that the latter is undoubtedly to be preferred. It is obvious that when a programme is disclosed beforehand in its entirety, as was done with the Naval Defence Act, competitors are fully informed and can make arrangements (working on a plan mutually devised or under a common agreement) by which the effort decided upon by Great Britain can be matched and neutralized. On the other hand, as Great Britain possesses an enormous superiority in shipbuilding resources, and can produce vessels more rapidly and at less cost, it is her wisest policy to publish only the programme of construction for each year, based on the numbers and types of vessels which may have been laid down abroad, taking care that the completion of British ships shall always be secured before that of corresponding foreign types.

Battleships of 1894.—In 1894 the largest battleships in the Royal Navy were vessels of the *Royal Sovereign* class, 380 feet in length, 75 feet in breadth, of 14,150 tons displacement and 17 1-2 to 18 knots maximum speed, carrying four 13 1-2-inch guns and ten 6-inch quick-firing guns, besides smaller weapons. The largest cruisers afloat were the *Blake* and *Blenheim,* designed in 1888. They are 375 feet in length, 65 feet in breadth, about 9,100 tons displacement, with a maximum speed of 22 knots.

Cruisers of 1894.—The first-class cruisers of the *Edgar* class, built under the Naval Defence Act, were somewhat smaller than the *Blake* and *Blenheim,* and their maximum speed was about 21 knots. The second-class cruisers were of two types: one of 4,300 tons, the other of about 3,500 tons. All had a speed of about 20 knots. All the cruisers had protective decks and no side armor. Battleships and cruisers had cylindrical tank boilers, with closed stoke holds and forced draft.

Torpedo Gun Boats of 1894.—The torpedo gun boats of the *Sharpshooter* class were designed as the smallest type capable of independent sea service and as adjuncts to a fleet. They were 230 feet long, 27 feet broad, of 735 tons displacement, and were fitted with locomotive boilers intended to develop 4,500 horse power, corresponding to a maximum speed of 20 knots. Locomotive boilers, when fitted in "groups," failed to realize the intended power, although it should have been easily obtained on the basis of results secured with one or two boilers in many torpedo boats previously built. The sister ship *Speedy,* was constructed (1892-93) with water tube boilers of the Thornycroft type, and the stipulated engine power was easily realized, the original estimate for speed being verified on trial. This was the first vessel in the Royal Navy, above the size of torpedo

*Paper read before the International Engineering Congress, St. Louis, Mo., October 8, 1904.

[1]Late Director of Naval Construction, England.

boats, fitted with water tube boilers. In recent years these vessels have been re-engined and fitted with water tube boilers, attaining speeds of 21 1-2 knots.

Armor.—The armor used on the ships of the Naval Defence Act was for the most part steel faced iron; but in some of the vessels all-steel armor was introduced for the first time in the Royal Navy as the result of experiments which had been initiated in 1888. Nickel steel armor of moderate thickness was used for the protection of superstructures.

Majestic Class.—In 1894, a further scheme of construction was begun, known as the "Spencer programme." This led to the design of battleships of the *Majestic* class. The characteristic features of these vessels are too well known to need detailed description. They are 10 feet longer than the *Royal Sovereign* class and of 14,900 tons displacement. The disposition of the armor on the hull differed essentially from that of the *Royal Sovereign* class, the armor on the citadel being of uniform thickness and no water line belt being fitted. The arrangements of the protective decks were modified. The use of Harveyed armor gave a large increase in defence for a given weight and thickness of armor, as compared with the all-steel armor, or the steel faced iron armor, which had been previously used. The first experiments with Harveyed armor were made in England at the end of 1892, the system having been introduced to the Admiralty by a representative of the Harvey Company of the United States. English armor plate makers had previously patented processes of a similar character; but action taken in the United States by Mr. Harvey and those who supported him led to the perfection and practical adoption of this system. For the principal armament of the *Majestic* class, guns of 12-inch caliber were adopted instead of the 13 1-2-inch guns of the *Royal Sovereign* class. Had a satisfactory and well proved type of 12-inch gun been available in 1889, it would have been adopted. The 13 1-2-inch gun was used in the *Royal Sovereign* class because it was immediately available, and because past experience had shown that in order to secure rapid and economical construction it was absolutely necessary to determine the nature of the armament before the work of building war ships was begun. This principle still holds good; neglect of it inevitably leads to delays, increased expenditure and other unsatisfactory results. The secondary armament of 6-inch, quick-firing guns in the *Majestic* class was much better protected than that of the *Royal Sovereign;* the casemate protection being much extended, while greater facilities were provided for the service of ammunition along well-protected passages, lying low in the ship. Both these features had been recognized previously to be important, but equal effect had not been given to them in earlier designs. It is now universally admitted that the principles illustrated in the *Majestic* class are of paramount importance to fighting efficiency. With quick-firing guns and high explosives it is essential to provide adequate protection for the secondary armament and for the men employed thereat, as well as for the transport of the ammunition. Large supplies are required with quick-firing guns, the magazines must be kept cool to prevent deterioration of the charges, and provision must be made for rapid supply of ammunition to the guns, if the full efficiency is to be realized. Provided these conditions are fulfilled, it may well prove advantageous to adopt less numerous but better protected armaments, and mere multiplication of guns may involve reduced fighting power. For defence against torpedo attacks a considerable number of quick-firing guns were mounted in all Naval Defence ships, and torpedo nets were fitted to the battleships and largest cruisers. By common consent the *Majestic* class is regarded as having greatly influenced all subsequent battleship construction.

Powerful and Terrible.—The year 1894 also witnessed the design of the protected cruisers *Powerful* and *Terrible,* which were built for the purpose of meeting the Russian cruisers *Russia* and *Rurik.* The water line region of the Russian ships was protected, for a portion of the length, by a narrow belt of vertical armor, and they carried a large number of guns practically destitute of armor protection. After full consideration of their offensive and defensive qualities, it was decided, in the *Powerful* and *Terrible,* to adopt a strong protective deck as the main defense of the vitals, rather than to fit a narrow belt of vertical armor over a portion of the length of the water line. It was also decided to accept a smaller number of guns, but to provide efficient armor protection for the 6-inch and 9.2-inch guns. The service of the ammunition was arranged, not merely so as to secure adequate and rapid supply, but to give thorough protection during its transport from the magazine to the guns. A great superiority in speed and coal supply was also secured in the *Powerful* and *Terrible,* their dimensions being correspondingly increased.

Perhaps the most notable feature in the vessels was the adoption of water tube boilers of the Belleville type. This step has been strongly condemned on the ground that it was unwise in war ships of such unprecedented power and speed to adopt a type of steam generator which was regarded as experimental. It is not necessary to justify what was done in these vessels; but it may be stated that the strong and capable committee, appointed four years ago by the Admiralty to investigate the general subject of water tube boilers fitted in war ships, has approved the action which was taken by the Admiralty in 1894. Moreover, it is undoubted that, unless water tube boilers had been adopted, the design of the *Powerful* and *Terrible* would have been impossible apart from greatly increased dimensions and cost. Even when favored by the adoption of this light type of boiler, their dimensions far exceeded those of any other cruisers, although they were still much inferior in size to the largest and swiftest passenger steamers of that period. The length of the *Powerful* was 500 feet; beam, 71 feet; displacement, 14,200 tons; speed, from 22 to 22 1-2 knots, and horse power, 22,000. As the vessels were intended for distant and long continued sea service, it was decided to sheathe their bottoms with wood and copper, in order to prevent fouling and consequent loss of speed. These features involved more than 600 tons additional weight and increased the cost by about £45,000. If the vessels had been built with bare steel bottoms, like more recent cruisers, the displacement would have been about 13,500 tons. This fact has been very generally overlooked by critics of the design, who ignore the importance attached by the Admiralty to sea-keeping capability and power of maintaining speed for long periods on

stations where docks are not available. The adoption of water tube boilers in the *Powerful* and *Terrible* was naturally followed in other classes of ships. In this policy French naval authorities had led the way, and French experience was necessarily drawn upon when the new departure was under consideration. For a time battleships were still fitted with cylindrical tank boilers; but since 1896 there has been universal use of water tube boilers for all classes of ships in the Royal Navy. Difficulties there have been, no doubt, as must have been anticipated with such a great experiment in a new direction. As experience has been gained, and the relative merits of competing types of boilers have been practically determined, these difficulties have been overcome. The great advantages obtainable with water tube boilers have been confirmed, and their comparatively inferior economy in coal consumption has been remedied. The Admiralty Boiler Committee, in preliminary reports (1903) advised the use of a combination of tank and water tube boilers in order to secure greater economy of coal when cruising at low speeds. In the writer's address in November, 1903, at the Institution of Civil Engineers, he stated that this system was carefully considered in designing the *Powerful* class, and was set aside in favor of a complete installation of water tube boilers. Further, he ventured the opinion that the boiler committee would eventually reach the same conclusion. It is interesting to note that this anticipation has already been realized, and that for the latest designs the committee has recommended the exclusive adoption of water tube boilers for H. M. ships. As yet the determination of the best types for use is still incomplete. Experience alone can settle that question, and it is probable that no single type will be found suitable for all conditions and classes of ships. The tank boiler has been brought to its present state of efficiency by a long period of use and successive steps in improvement. Critics of water tube boilers fail to make allowance for their recent introduction and the limited experience hitherto gained in actual sea service. But the advances already made are a guarantee of ultimate success and widely extended use for water tube boilers, if the steam engine continues to be used for ship propulsion.

TORPEDO BOAT DESTROYERS.

In 1894 the earliest examples of torpedo boat destroyers had just been completed and subjected to experiment. The results were so satisfactory that the Admiralty decided immediately to raise the total number of destroyers to 42, and in order to insure rapid advancement of construction, the orders were widely distributed, and a flotilla was thus made ready for service in an unprecedentedly short time. The design of these vessels was based upon that of torpedo boats, but they were much larger; the length was about 200 feet and displacement about 250 tons, with speeds of 27 knots. In consequence of their larger dimensions and armament of quick-firing guns, these destroyers could run down in a sea way and destroy any torpedo boats of that period. They also carried a considerable torpedo armament, which at first was treated as alternative to the gun armament, but eventually carried in association therewith. Very considerable developments of the type have been made since 1894, and the lead of the Admiralty has been followed in all navies. Probably the most interesting circumstance in connection with the construction of these destroyers was the fact that when the necessity arose for rapid additions to this class it was found possible to distribute the orders among fourteen firms, who undertook and successfully carried out the contracts; although up to that date Messrs. Thornycroft and Messrs. Yarrow had built nearly all the vessels of the torpedo flotilla constructed in England, while Messrs. White, of Cowes, and Messrs. Laird of Birkenhead, had undertaken some work of that class. There had been no more remarkable evidence of the unrivalled shipbuilding resources of Great Britain. Within a short period the country was put into a position to deal with the formidable menace of torpedo attack on its fleet, when in channel ports, which previously threatened its safety.

SUBMARINES.

The construction of submarines in England had been intermittent and very limited in extent up to 1894. Four or five vessels of the class had been built, the largest and best boats by Mr. Nordenfelt, from designs largely due to Mr. Garrett, who also undertook the superintendence of the trials. Greece and Turkey acquired the vessels as built, but the Admiralty did not make any purchases. Another submarine vessel built on the Thames attracted attention a few years earlier (1887). She was named the *Nautilus,* and the writer had some personal experience of her qualities, not altogether satisfactory. No other vessels of that type were laid down; and, indeed, there was no feeling in favor of submarines in the British navy ten years ago, although it was always held that, if the construction of the class was desired, there would be no difficulty in meeting requirements speedily. The principles of construction for the type were fully understood, and their moderate dimensions enabled the multiplication of any selected type to be rapidly accomplished; but there was no desire to adopt the system for the British navy.

STEAM TURBINES FOR SHIP PROPULSION.

In January, 1894, the first steps were taken by Mr. Parsons and those associated with him to apply his system of steam turbines to ship propulsion. The first trial of the *Turbinia* was made in November of that year. For fully two years the experiments with that notable vessel were continued, 31 trials being made, 7 different arrangements of propellers tested, and final success achieved with three turbines, each driving a shaft with three propellers on each shaft. It is impossible to speak too highly of the courage and skill displayed by Mr. Parsons in this enterprise, which ended in a little vessel of 100 feet in length and 44 1-2 tons displacement attaining a speed of 34 knots. A new era was thus entered upon in ship propulsion, and although (owing to various accidental circumstances) the development of the system has been much delayed, the merit of the work done by Mr. Parsons and the enterprise shown by the gentlemen who formed the original syndicate are now beginning to have their full effect. This new departure was made concurrently with a remarkable development in the use of the "express" type of reciprocating engine in destroyers and small cruisers; but the advantages obtainable in the rotary type of engine were so great that there could be no doubt of the ultimate result of the contest,

especially in ships of the mercantile marine, which, from the conditions of their service, are constantly working at or about the maximum engine power. At full power the turbines have their greatest efficiency, and exceed the best reciprocating engines in economy of steam, whereas their relative economy diminishes as the development of power decreases, and at low powers they become inferior to the reciprocating type.

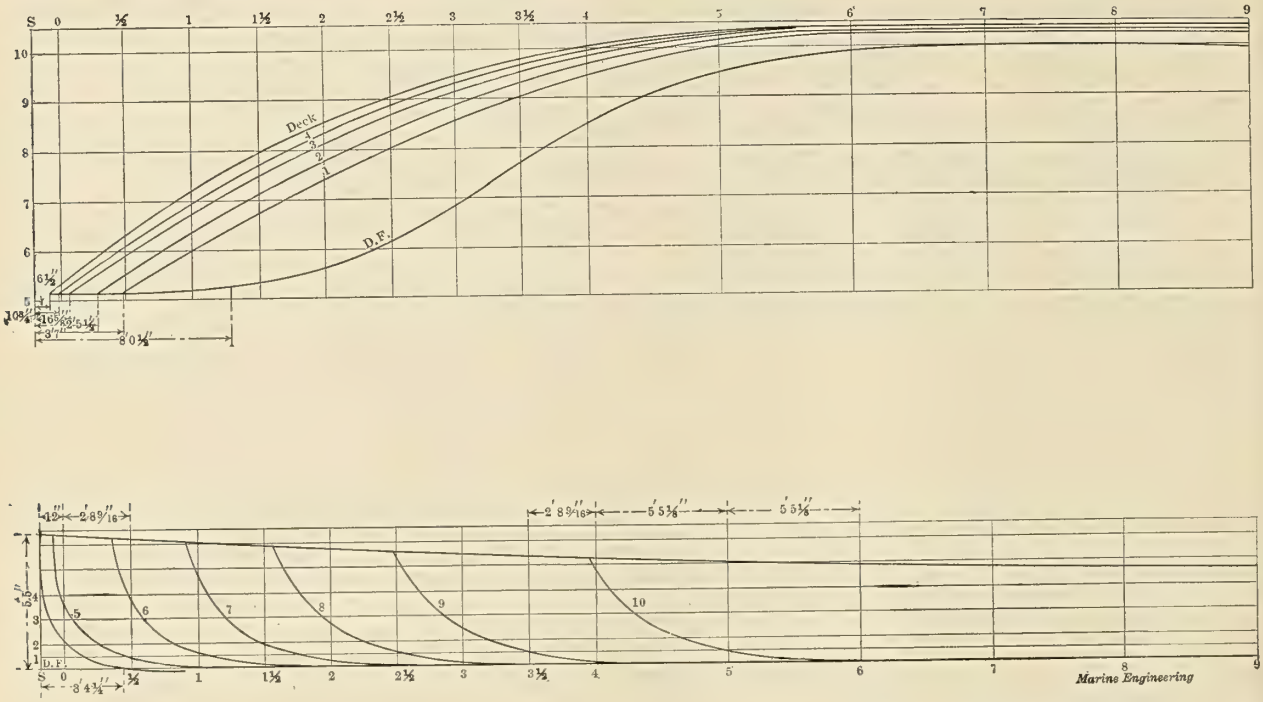
THE BRITISH MERCANTILE MARINE IN 1894.

The British mercantile marine was entering upon a period of expansion in 1894 after a year of unusually small production of new ships. From 1889 to 1892 the gross tonnage of ships launched per annum had been from 1,100,000 to 1,200,000 tons; in 1893 this total fell to about 836,000 tons, and in 1894 again rose to 1,046,000 tons. The largest ships launched in 1894 were the *Caledonia* and *Norman,* about 490 feet in length, 7,500 tons gross and 10,000 to 11,000 I. H. P. The largest sailing vessel launched was the *Pitlockry* of 3,100 tons gross. In 1894, 133 steamers were launched, ranging from 3,000 to 7,000 tons, as against 92 steamers of smaller size launched in 1893. This indicated a tendency to an increase in the size of the individual cargo steamers. The largest vessels of that class on the British register in 1894 were about 480 to 500 feet in length and 8,300 to 8,700 tons gross. That year was also distinguished by the construction of five cargo steamers of the turret type, the first of which had been built in 1892; but the largest of these was only 340 feet in length and of 3,200 tons gross tonnage. One cargo steamer of 10,000 tons was building in 1894, and was launched in the following year. She may be regarded as the predecessor of the modern type of large dimensions which has since grown so much in favor with ship owners. On the Atlantic service the *Campania,* 600 feet in length and of nearly 13,000 tons, had just commenced her service, and her sister ship, the *Lucania,* was completed. During 1894 the *Campania* proved herself capable of maintaining a speed of over 22 knots at sea, with about 30,000 I. H. P. Among cross channel steamers of that date, those used on the service between Dover and Flushing were the fastest, reaching a speed of about 22 knots. They were about 340 feet in length and of about 1,450 tons gross, developing over 8,000 horse power on service. On the Dover-Calais route the largest vessels were about 325 feet in length and of about 1,100 tons gross tonnage, with a speed of about 20 to 21 knots, obtained with 6,500 horse power. Very soon after steps were taken by the City of Dublin Steam Packet Company to construct four new vessels (the *Ulster* class) 360 feet in length, of 2,600 tons gross, which obtained a trial speed of over 24 knots with 9,000 I. H. P. The united kingdom still held the lead in regard to the speed and size of all classes of mercantile steamships, and maintained it up to 1898, when the North German Lloyd took the lead with the *Kaiser Wilhelm der Grosse,* nearly 25 feet longer than the *Campania,* and nearly 2,000 tons greater in tonnage; the maximum speed on service being about half a knot faster than that of the *Campania* and *Lucania.* The *Oceanic* of the White Star line was built almost concurrently with the German ship, and (as the writer has explained more fully elsewhere) the late Mr. Thomas Ismay decided that with then existing subsidies paid to British steamships, it was not possible to work such vessels at a commercial profit at higher speeds than that which had been decided upon for the German steamer. His view was that the least saving in time on the voyage to New York, which would be of practical value, was 12 hours; and that the consequent increase in size, cost, and working expenses could not be made in association with commercial success. It would have involved about 30 per cent. increase in power, and 20 per cent. on the coal bill, besides reducing the freight earning power by about 40 per cent. Consequently, it was decided that, although the *Oceanic* was 60 feet longer than the *Kaiser Wilhelm der Grosse* and of nearly 3,000 tons greater tonnage, the maximum horse power should be only 27,000, corresponding to a speed of about 21 knots on service, and such a reserve of boiler power was provided as insured practical regularity in the period occupied by the voyage. It was no lack of enterprise on the part of Mr. Ismay and his associates which led to this decision, and the lead in speed was virtually handed over to the German lines because there was then no inclination on the part of the British government to give such substantial assistance toward the construction of vessels of exceptional speed as has been recently granted to the Cunard Steamship Company.

Twin screws were coming rapidly into favor for mer chant steamers in 1894, their advantages having been demonstrated in war ships of deep draft during the preceding twenty-five years. In 1878 the writer summarized the experience with twin screws up to date, and warmly advocated their adoption in the mercantile marine. Little was done, however, until ten years later, and the most notable departure was made when the *Teutonic* and *Majestic* of the White Star line and the *Paris* and *New York* of the Inman and International line were constructed (1888-89). Since that date the use of twin screws in all classes of merchant ships has rapidly extended, and enlarged experience has emphasized their great superiority not merely as giving greater safety but more efficient propulsion.

MATERIALS OF CONSTRUCTION IN 1894.

Mild steel of the quality which the British Admiralty began to specify for war ships in 1875 had practically superseded iron for all classes of ships long before 1894. In that year 98.6 per cent. of the new steam tonnage was built of steel, and only 1.2 per cent. of iron, the latter material being used chiefly for trawlers and very small vessels. A longer interval elapsed with merchant ships than with war ships in making this change of material, partly because up to 1891 mild steel was dearer than iron of the qualities commonly used, and partly because there were lingering doubts as to the trustworthiness of steel and its relative corrosion in sea water. The Allen liner *Buenos Ayrean* had been built of mild steel by Messrs. Denny as early as 1879, and as experience increased, so the new material gained in favor. Its good working qualities, uniformity of strength, great ductility and excellent behavior in cases of collision, grounding, and other accidents, all tended to establish it in favor, and experience up to date has been so satisfactory that there is, even now, no general desire to introduce any substitute for mild steel. The use of steel castings, instead of heavy iron forgings, for important parts of the structure



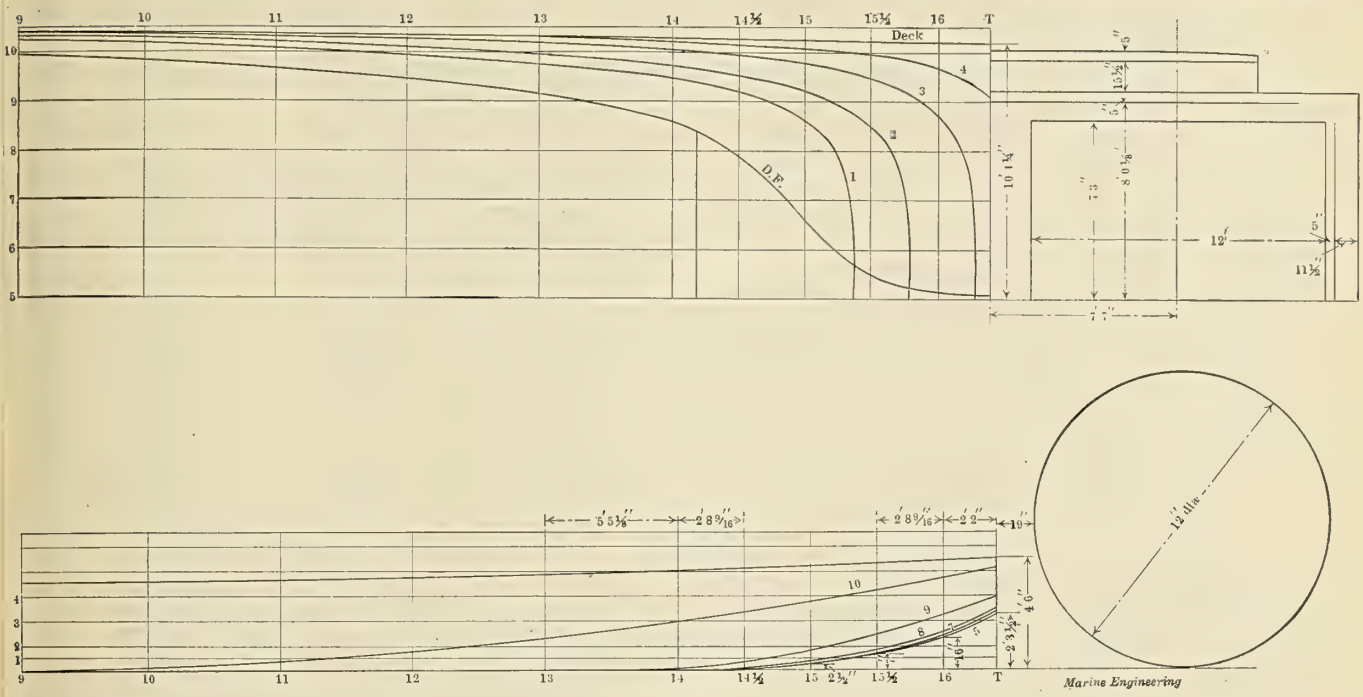
LINES OF THE SHALLOW DRAFT STERN WHEEL

such as stems, stern posts, shaft brackets, rudder frames, began about twenty years ago; by the year 1894 they had come into common use. For war ships with ram stems, large rudders and out board shafting, the use of steel castings has effected remarkable economies in both the cost and the time of manufacture. Enlarged experience has enabled manufacturers to obtain castings of complicated and difficult sectional forms, tending to considerable reduction in weight and to improved fastenings and attachments to other portions of the hull. Looking back upon the history of this particular application of mild steel (in which, owing to the writer's association with the Elswick firm during the period 1883 to 1885, he had an intimate personal connection), it is most singular to note how shipbuilders were for a considerable time prepared to condone or minimize defects in iron forgings; whereas in regard to steel castings they insisted upon severe tests and the most careful examination before acceptance. For example, if the falling tests regularly imposed upon steel castings had been applied to iron forgings, there can be no doubt that, in many instances, the latter would have utterly failed. But many of those who offered the most strenuous opposition to the use of steel castings never suggested that iron forgings should be similarly tested. In passing it may be added that the work done by British investigators and manufacturers in recent years in the improvement of steel castings—a work in which Mr. Hadfield of Sheffield has borne a most distinguished part—appears to justify the hope that in the future it will be possible to substiture steel castings, subjected to a special heat treatment, for many portions of ship structures where steel forgings are now used. Here, indeed, is a field of promise which has long been in view, although its exploration has been deferred; and if the dream that furnace treatment and chemical composition can be substituted for many mechanical processes of pressing or hammering can be realized in practice, then great further economies of weight and cost should be possible.

ALUMINUM FOR SHIPBUILDING.

Prior to 1894 there had been discussions of the possibility of using other materials than steel in special classes of ships. Aluminum and its alloys found most favor, but the use of certain bronzes was also advocated. In 1892-93 two small aluminum launches were built at Zurich, and in 1894 another aluminum launch was at work on the Thames. In that year Messrs. Yarrow built a second-class torpedo boat of that material, and several yachts were similarly constructed. In all cases considerable economies of weights were obtained, but the alloy used proved to be wanting in durability when exposed to the action of sea water. The broad conclusions reached on the basis of this experience were, that while pure aluminum had not the requisite strength, or working qualities, for the purposes of shipbuilding, the alloys obtained up to 1894 were wanting in durability. Messrs. Yarrow have not proceeded further with the system; nor has the French navy continued to use it. It has been alleged, recently, that aluminum bronzes have been obtained which combine ductility and good working qualities with non-corrodibility in sea water. It does not appear, however, that any extended use has been made of the material, but for internal fittings in ships, for some portions of the machinery and for superstructure there can be no doubt that, at least, in special classes of vessels, there may yet be a future for such alloys.

(To be continued.)



STEAMER SASKATCHEWAN, BUILT BY HUDSON'S BAY COMPANY, CANADA.

MARINE ENGINEERING DATA CARD. NOVEMBER, 1904.

NAME—Saskatchewan. NATIONALITY—Canadian. TYPE—Stern paddle wheel.

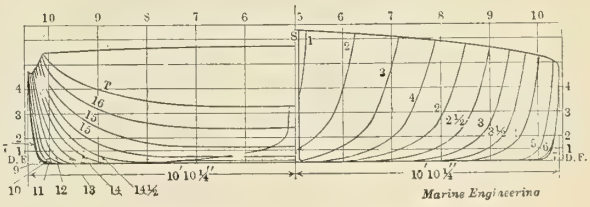
DESIGNER—Marine Iron Works, Chicago, U. S. A.

LAUNCHED—1904. BUILDERS—Hudson's Bay Company. OWNER—Hudson's Bay Company.

Length over all	105 ft. 0 ins.
" of hull	90 " 0 "
Beam	22 " 0 "
Width over guards	25 " 0 "
Depth	3 " 9 "
Draft, loaded	24 "
Displacement	90 tons
Engines:	
Type	double high pressure
Cylinder diameter	9 ins.
Stroke	42 "
Valves	balanced piston
Length of pitman	16 ft.
Wheel:	
Shaft, diameter	5 1-2 ins.
Wheel, "	12 ft.
Number of buckets	12
Length " "	14 ft. 6 ins.
Width of each bucket	14 "
Revolutions	35
I. H. P.	117
Speed with load	10 miles
" light	12 1-2 "
Boilers:	
Number	1
Type	locomotive firebox
Diameter	48 ins.
Length	17 ft.
H. S.	666.22 sq. ft.
G. S.	16.02 " "
Steam pressure allowed	180 lbs.

STERN WHEEL STEAMER SASKATCHEWAN, FOR THE NORTHWEST.

The latest addition to the fleet of shallow-draft steamers, owned and operated by the Hudson's Bay Company of Canada, the *Saskatchewan,* was recently built by that company from plans furnished by the Marine Iron Works. She is a stern wheel paddle steamer, 90 feet length of hull, and with a load draft of 24 inches.



BODY PLAN OF THE SASKATCHEWAN.

The main deck is inclosed for carrying freight, while on the upper deck is a saloon with accommodations and state rooms for several passengers.

The Hudson's Bay Company was incorporated A.D. 1670, and with a knowledge gained through an active experience of two hundred and thirty-five years in hand with unlimited resources and equivalent energy, has most successfully covered the waters of the extreme north and northwest territories of Canada. The company's map indicates about two hundred important forts and stations; its principal offices being located in Winnipeg. The company furnishes excellent transportation by its own steamers and fleets of boats navigating all the

principal lakes and streams throughout the territories not traversed by railways. The many difficult features of operation, at times conflicting conditions, have all been successfully met by the very capable and experienced force in charge of their various boat lines.

Although the *Saskatchewan* is one of the smaller of their river steamers, she is worthy of especial mention as being built by the Hudson's Bay Company from model plans and specifications furnished by the Marine Iron Works, Chicago, Ill., who also made the entire and complete outfit for driving machinery, with auxiliaries, special deck equipment, ironing for the hull, and all the necessary fastenings.

STEAMER SASKATCHEWAN, FOR THE HUDSON'S BAY COMPANY

The machinery consists of two high-pressure engines 9 inches diameter by 42 inches stroke driving cranks in each end of the wheel shaft. This shaft is 5 1-2 inches diameter and is fitted for carrying 12 buckets 14 feet 6 inches long and 14 inches wide with greatest diameter of 12 feet. At 35 revolutions the engines indicate 117 horse power and give a speed of 10 miles when the vessel is loaded. Steam is supplied at 180 pounds by one locomotive fire-box boiler with 16 square feet of grate surface and 666.22 square feet of heating surface.

The performance of this boat is, indeed, most creditable to the designers and builders.

Coal-Handling Machinery.

BY JOSEPH C. HOSHER.

Machinery for handling coal is rapidly being installed in almost every branch of industry where coal is used as a fuel, for the necessity of labor-saving machinery in this line is generally appreciated. For the past decade the production of coal in the United States has been increasing about 4 per cent. annually, till that for 1903 reached the enormous figures of 367,000,000 tons, with a valuation of the product of $390,000,000.

This increased production has necessitated the introduction of labor-saving machinery in every branch of this vast industry. Coal mining is now done largely with improved machinery. The means of transportation has been augmented and millions have been invested in the equipment of railroads, making it possible by increasing the capacity of cars from forty to eighty tons, to carry coal at a profit on the basis of 3-10ths of one cent per ton mile, whereas ten years ago coal could not be carried at a profit by railroads at less than 5-10ths of a cent per ton mile and yield a profit. Water rates, likewise, have been reduced by building vessels of large capacity, ranging from 3,500 to 8,000 tons, and by discharging the cargo by machinery. With many of these specially-designed vessels, when the discharging is carried on throughout by automatic machinery, it is possible

to reduce the expense of discharging the cargo to less than one cent per ton.

The grab bucket is used in large discharging plants, and has the usual capacity of 2 1-2 tons. In an ordinary lift the grab bucket will make a trip, taking out the vessel and depositing in storage its load, in thirty to thirty-five seconds. A single tower will discharge, under ordinary circumstances, 1,200 to 1,500 tons in a working day of ten hours, and with four towers working over four hatches a 5,000-ton cargo can be unloaded in twelve hours.

The saving of time in the discharge of vessels is a large consideration to the owners, as the estimated gross earnings of a 5,000-tons capacity ship should be about $300 per day. For this reason the vessel owners always make a liberal allowance for prompt discharge, and it is fair to assume that the improved machinery, which is capable of discharging a ship's cargo in a single day, earns for its owner, in a rebate from the charter price per ton, a sufficient amount to justify him to install the very best discharging machinery possible, and the earning capacity of the ship is increased by an amount represented by the income of the days saved while his vessel would otherwise lie idle.

Machinery of this character, while it does extremely heavy duty and its requirements are exacting from the nature of the work, must be built strong and durable. Many builders have abandoned the idea of constructing anything but the best, as it has been found from sad experiences that only the machinery built of the best material and along safe lines is economical to the purchasers. Those who have purchased light machinery because it was cheap, have paid very dear for their experience, and many plants where cheapness in first cost was the chief consideration, have since been rebuilt.

The purchasers in many instances were not to blame, as the business of coal-handling machinery had hardly passed through the first twenty years. The necessity for efficient machinery has been so keenly felt that now, with ingenious devices, the cost of handling the coal is very much lower than manual labor could do the same work for. This idea having been taken up by some very able and patient men, they have adjusted suitable machinery to the conditions of the times, with the result that a large amount of machinery has been built which is saving time, labor, annoyance from labor organizations, and paying handsome returns for the investments. Coal-handling machinery is practically in its infancy. There is not a single commodity with such vast tonnage that the handling of it by machinery is in such a crude state. It is fair to assume that less than 10 per cent. of the coal produced in the world is handled by machinery. In many of the sea ports of the world, coal is now being handled the same as was done a hundred years ago. In the port of Genoa, Italy, with the cheap labor of that country, it costs thirty-eight cents per ton to discharge coal and land it on the dock. In Yokohama, Japan, about the same price, and in Manila, P. I., forty-five cents per ton. Cheap labor cannot compete with improved machinery, and it will be but a question of time when many of the sea ports of the world will have coal-discharging plants, which will thereby bring to the users of coal a reduction in its price, by the introduction of labor-saving machinery.

Launch of the Italian Battleship Regina Elena.

The first-class battleship *Regina Elena,* of the Italian navy, was launched on June 19 at the royal yard of Spezia. This ship is the first of four similar vessels recently ordered by the Italian government, and is of the *Vittorio Emanuele* type, which was widely discussed in the technical world a few years ago. The purpose of the designer, Mr. Vittorio Cuniberti, was to combine in a moderate displacement of 12,625 tons, the defensive and offensive power of a battleship, with the speed of the cruiser. The principal dimensions will be found in the accompanying table.

The hull is of steel throughout, and the stem and stern posts and propeller brackets are of cast steel. The armor is face-hardened. The motive power consists of two sets of triple-expansion engines designed to develop 20,000 I. H. P., and 28 Belleville water-tube boilers. The designed speed is 21.5 knots, and with a bunker capacity of 2,000 tons of coal the estimated steaming radius, at moderate speed, is 10,000 miles. Electricity is used throughout for lighting, steering, hoisting ammunition and operating turrets.

A 10-inch water-line belt of armor extends the length of machinery space and tapers to 4 inches at the ends. The central redoubt is 8 inches thick and a 3 1-8-inch protective deck is worked in forward; the large turrets have 10-inch armor, and the smaller turrets are 6 inches thick.

MARINE ENGINEERING DATA CARD. NOVEMBER, 1904.

NAME—Regina Elena. NATIONALITY—Italian. TYPE—Battleship.

LAUNCHED—1904. BUILDER—Royal Dock Yard at Spezia. OWNER—Italian Navy.

Length over all	474 ft. 6 ins.
" between perps	435 " 0 "
Breadth, extreme	73 " 6 "
Draft, mean trial	25 " 9 "
Displacement, trial	12,625 tons
Launching weight	5,700 "
Coal supply, maximum	2,000 "
Steaming radius, 10 knots	10,000 miles
Speed, trial, estimated	21 1-2 knots

Batteries:
Main: 2, 12-in. B. L. R. Armstrong; 12, 8-in. B. L. R.
Secondary: 8, 3 1-8 in. R. F. G.; 12, 1 7-8-in. automatic; 4, canister; 2, 3-in. field.

Armor:
Water line belt amidships, 10 ins., tapering to 4 ins. at ends.
Central redoubt.....8 ins.
Turrets:....12-in. guns, 10 ins.; 8-in guns, 6 ins.

Machinery:
2 sets triple-expan. engines 21,000 I.H.P.
28 Belleville water-tube boilers.

Two Armstrong 12-inch 40-caliber guns are mounted on the center line in 10-inch turrets, one gun forward, one gun aft. The weight of the gun is 51 tons, the charge of powder weighs 450 pounds, and that of the projectile is 850 pounds. Each gun has a radius of fire of 300 degrees and is supposed to discharge two shots per minute. The projectile will perforate 13 inches of Krupp armor at 2,000 yards. Twelve 8-inch guns are mounted in pairs in turrets amidships. These guns are Armstrong 45-caliber and weigh 19 1-2 tons; their charge is 122 pounds, and that of the projectile 230 pounds; they will perforate 7 inches of Krupp armor at 8,860 feet.

THE ITALIAN BATTLESHIP REGINA ELENA, LAUNCHED FROM THE ROYAL YARD, AT SPEZIA.

The secondary battery consists of eight 3 1-8-inch 40-caliber guns, 4 in barbetts, two at stem, and two at stern, and four advantageously distributed at sides. These guns are for repelling torpedo boats and destroyers. The rest of the battery consists of twelve 1 7-8-inch rapid-fire guns, four canister guns, and two 3-inch landing pieces. The concentration and intensity of fire in one minute is as follows:

Bow or astern fire.—One piece of 12 inches, 2 shots; weight of the projectiles, 900 pounds; dinamodi, 23,000; eight pieces of 8 inches, 32 shots; weight of projectiles, 4,360 pounds; dinamodi, 115,200; two guns of 3 inches, 40 shots; weight of projectiles, 600 pounds; dinamodi, 8,400.

Broadside firing.—The two 12-inch guns, 4 shots; weight of projectiles, 1,800 pounds; dinamodi, 4,600; six pieces of 8 inches, 24 shots; weight of projectiles, 5,520; dinamodi, 86,400; six guns of 3 inches, 120 shots; weight of projectiles, 1,824 pounds; dinamodi, 25,200.

It is to be remarked that the 6-inch gun generally used for the secondary battery is absent in this ship. It is claimed by Mr. Cuniberti that as the 6-inch gun at 3,000 yards can penetrate but 3 inches of modern armor, this gun is ineffective against lightly-armored vessels at probably battle range, while the chief work they will have to do will be to drive off the smaller torpedo boats, against which the 3-inch guns are almost equally effective.

Dagnino Attilio.

THE PRESIDENT ACTS UPON THE SLOCUM REPORT.

Acting upon the report of the federal commission appointed to investigate the *Slocum* disaster, President Roosevelt, on October 15, gave orders and made suggestions that will revolutionize the United States Steamboat Inspection Service.

His orders are in the form of a letter addressed to Victor H. Metcalf, Secretary of Commerce and Labor, and are as follows:

"My Dear Sir:—I have received the report of the commission of the United States on the investigation of the *General Slocum* disaster, and the report of the Department of Justice, of October 12, recapitulating what has been done by the Department of Justice in

connection with the criminal proceedings taken against various individuals because of their connection with the disaster. I send you herewith both reports. Punitive action by the government can of course only take two forms; one, that of legal proceedings against those either within or without the service, and two, removal from office of those within the service.

"It appears that the Department of Justice has already secured indictments against the master and captain of the *Slocum* and against the managing directors of the Knickerbocker Steamship Company, to which company the *Slocum* belonged, for misconduct, negligence and inattention to duty by the captain and for aiding and abetting therein by the managing directors. Furthermore the Department of Justice has secured indictments against Henry Lundberg and John W. Fleming, the assistant inspectors of the steamboat inspection service, who actually inspected the *Slocum*, for fraud, misconduct and inattention to duty.

"Lundberg had been appointed merely on probation in the service and has been dropped. There can, of course, be no further action taken about Fleming until his trial has been finished, although it does not follow that an acquittal would prevent the department from discharging him from the service.

"In addition, the Department of Justice has secured the indictment of the manager and three employees of the Nonpariel Cork Works, of Camden, N. J., for putting upon the market compressed cork blocks for use in making life preservers, each of which blocks contained in its centre a piece of bar iron weighing several ounces. This last offence was of so heinous a character that it is difficult to comment upon it with proper self-restraint. It appears that the national legislature has never enacted a law providing in set terms for the punishment of this particular species of infamy, doubtless because it never entered the head of any man that so gross an infamy could be perpetrated.

"I suggest that you report this whole matter to congress, transmitting these two reports, and at that time calling special attention to the need of imposing an adequate penalty for the making or selling of defective life saving appliances.

"So much for what the Department of Justice has done in reference to the disaster. But in addition to the men put on trial by the Department of Justice, action should be taken against those employes whose responsibility for the state of things producing the accident has been brought out in the report of the commission.

"According to this report it appears that in addition to the two assistant inspectors who are now on trial, the supervising inspector of the Second district, Mr. Rodie, and the two local inspectors of the Port of New York, Messrs. Dumont and Barrett, should all three be removed for laxity and neglect in performing their duties.

"As regards the conduct of Mr. Rodie, Mr. Uhler dissents from the conclusions of the four other commissioners. I agree with the conclusions of the other four. Laxity and neglect, where the consequences may be as terrible as they have proved to be in this case, cannot be passed over even where there has been good conduct in other respects on the part of the man implicated. Accordingly the three officials named will be removed from the service.

"Moreover, you will please direct their successors in office at once to conduct a thorough examination of the entire inspection force of the Port of New York, with the object of weeding out all the men whom such examination shall show to be unfitted to perform the very arduous and responsible duties of their positions.

"The Supervising Inspector General has at present no headquarters force of special agents, so that it is undoubtedly very difficult for him to exercise any adequate and direct supervision over the various local divisions of the inspection service. In each division he must rely chiefly on the fidelity and energy of the local heads, and if these fail to perform their duty they must be held accountable. He must, however, exercise as thorough a supervision as the means at his disposal allow.

"In order that I may be informed as to the exact condition of the service in all its parts, I direct you to order a searching investigation, in continuance of the investigation of the commission, into the conduct of the central office and of every outside subdivision of the service save that in New York.

"You will also make such changes in the regulations as are recommended by the commission, and you will therefore call a special meeting of the Board of Supervising Inspectors for this purpose. You will also lay before the congress a request that the law be changed in the various particulars recommended by the commission. I wish particular emphasis laid upon the proposal of the commission that there be created by law a special body thoroughly to investigate the laws which are supposed to provide for the safety of passengers on steamboats, especially on excursion boats, where the prime causes of danger are the overcrowding and the flimsy and highly inflammable character of the superstructures.

"Very truly yours,

"Theodore Roosevelt.

"Hon. V. H. Metcalf,
"Secretary of Commerce and Labor."

REPORT OF THE UNITED STATES COMMISSION UPON THE SLOCUM DISASTER.

On June 15, the excursion steamer *General Slocum* was burned and beached in the East river, resulting in the burning to death and drowning of 955 men, women, and children, and the injuring of 175 others. Eight days after, George B. Cortelyou, then Secretary of Commerce and Labor, appointed a commission to investigate the disaster, and not alone to punish those guilty of the causes of this particular case, but to ascertain if changes in the present laws were necessary to prevent a repetition of the disaster. The commission was made up of the following men: Chairman, Lawrence O. Murray, assistant secretary of the department; Herbert K. Smith, deputy commissioner of corporations; George Uhler, supervising inspector general of the steamboat inspection service; Brigadier-General John M. Wilson, U. S. A., retired, and Commander Cameron McR. Winslow, U. S. N.

The hearings of the commission were held in New

York and Washington and the report, covering 62 printed pages, is given herewith in abstract:

"All the upper works of the *Slocum* were constructed of light woods and had been painted and varnished many times, and were, therefore, in a highly inflammable condition. In the construction of the vessel there were no safeguards against fire other than compliance with the regulations as regards the proximity of woodwork to boilers. The vessel had no fire-proof hatches or bulkheads and was entirely built of wood.

"The *General Slocum* was a vessel built to carry a large number of excursionists (2,500 allowed by law), and in her design there was apparently no consideration whatever given to the question of inflammability. In such a vessel a fire, once having obtained fair headway, could not be controlled and the vessel would be quickly consumed, as exemplified in the case of the *General Slocum.*

"There are many similar vessels doing service in the waters of the United States, the construction of which is quite as dangerous as that of the *Slocum,* and unless this kind of construction shall be prohibited or modified by law the safety of a large number of passengers carried by excursion steamers and steamers plying on the inland waters of the United States cannot be assured."

The report shows that the cabin of the *General Slocum* was filled with inflammable material, a large amount of oil being among its contents. It was lighted by electricity, but lamps were filled and burned there, and the crew frequently lighted matches in the compartment. On the morning of the disaster, Walter Payne, the negro porter, filled the lamps in the cabin. As there was not sufficient light he lighted a lamp, using a match; blew the match out and "threw it on the bench." Later, an oiler from the engine room entered the cabin, using as a light an open torch. The commission says on this point:

"The condition of this cabin, with the purpose for which it was used, constitutes one of the essential facts of negligence contributing to the disaster."

The apparatus of the vessel for fighting fire is described at length. The forward valve of the standpipe which was nearest to the place of the origin of the fire was about 30 feet from the entrance to the forward cabin.

"This forward valve and standpipe," says the report, "was supplied with a 100-foot length of cheap, unlined linen hose, costing probably less than 20 cents a foot, age unknown, but probably several years old. The rest of the fire apparatus on the main deck consisted of the after valve of the said standpipe, two hand fire pumps, located respectively in the bow and in the stern, and some 20 fire buckets were used, and the fire buckets were empty."

Upon the discovery of the fire by the crew "the so-called mate, Edward Flanagan," notified the captain and the two pilots, who were in the pilot house, through the main deck speaking tube. He then informed the engineer that the boat was on fire and asked for water on the fire line. With two or three of the deckhands Flanagan took down the linen fire hose. Daniel O'Niell, deckhand, opened the valve of the standpipe forward and turned the water into the hose.

The hose having fallen on the deck in a coil was twisted and kinked and as soon as it was subjected to water pressure it burst in two or three places, and simultaneously the hose itself was blown off from its own coupling where it was connected with the standpipe. Preponderance of evidence shows that no water came from the nozzle of the hose."

The report pays a tribute to Assistant Engineer Brandow, and also to Chief Engineer Conklin, who remained at their posts. It says: "Evidently Brandow did his full duty efficiently and courageously. He was at his post until the vessel was beached, for the engines were kept in motion until a few seconds before striking North Brother island.

The evidence of the pilots was that Captain Van Schaick received the first notice of the fire when the vessel was about four lengths to the eastward of Sunken meadows. He ordered full speed ahead and directed that the vessel be kept on her course. Subsequently he directed the pilot, Van Wart, to beach the vessel on North Brother island."

"The evidence before the commission establishes the fact that the master made no attempt whatsoever to fight the fire, to examine its condition, or to control, assure, direct, or aid the passengers in any way whatsoever. It is alleged that he was unable to reach the place where the passengers were, by reason of the fire, but this is contradicted by the evidence of many witnesses, and is obviously not true.

"An essential fact of negligence is the utter failure of the master to fight the fire or aid the passengers. In a less degree the pilots in the same manner, after beaching the boat and while there were still many passengers on board, failed in their duty to assist and rescue the said passengers. Very little assistance was given or control exercised by any of the officers or crew on behalf of the passengers."

Discussing the origin of the fire, the commission says that the evidence of people on the main deck is to the effect that they knew of the fire at the entrance to Hell Gate. In general, the evidence of people on the upper decks is that the first notice of fire on those decks was before the vessel had passed the middle of Ward's island. One witness testified that he knew of the fire at a point opposite a marble yard at Astoria. This marble yard is a conspicuous object near the entrance to Hell Gate.

"Reviewing the whole testimony," continues the report, "the commission believes that the first discovery of the fire on the main deck was before reaching Ward's island; that the mate, Edward Flanagan, knew of it at about that time, and to the westward of Negro Point Bluff, on Ward's island; and that he at once gave notice to the pilot house of the existence of the fire."

The evidence of the captain and pilots radically disagrees with statements of other witnesses, but the commission says that it is forced by the weight of the entire evidence to the belief that the "statements of the men in the pilot house as to the time when they first knew of the fire are incorrect, and that the evidence of the master and of the pilots as to the position of the vessel in the stream when the fire was first known to them must be disregarded.

"After a careful consideration of the entire testimony

as to the time of the discovery of the fire, the commission is of the opinion that the men in the pilot house had knowledge of the fire before the steamer passed the eastern end of Ward's island.

"The commission therefore believes that the master knew of the fire in time to have beached the vessel either in Little Hell Gate to the westward of the Sunken meadows, or in the Bronx Kills, to the eastward of the Sunken meadows, and to have thereby gained the great and essential advantage of placing the vessel with her stern to the wind so that the flames would be driven forward and away from the passengers, instead of taking a course that inevitably drove the flames rapidly aft, toward the passengers, and delayed the beaching of the vessel for several minutes longer than was necessary."

The commission declares that Pilot Van Wart showed bad judgment and lack of skill in beaching the vessel at a considerable angle with the shore line, thus leaving in deep water all but the bow of the ship, which was in in flames, and affording the passengers who could not swim little opportunity to save their lives. The commission believes that the vessel might have been beached so as to enable passengers to leap overboard and wade ashore.

As to the fire-fighting apparatus on the vessel the report says: "There is a strong probability that the fire would have been controlled had the fire hose been of the required statutory strength. Many of the life preservers were in bad condition, and, while it is probably true that many of these would have supported passengers in the water, the average passenger, seeing one torn, refused to use it or to try others, and the result was as disastrous as if the life preservers had been wholly unserviceable.

"The inefficiency and poor quality of the deck crew of this vessel, doubtless typical of the majority of the crews of excursion steamers," says the commission, "is one of the essential facts that caused the loss of so many lives."

In some detail the commission discusses the duties and responsibilities of the owners of excursion steamers, and then says:

"The commission is of the opinion that the owners of the *General Slocum* are censurable in a high degree for the inadequate and improper conditions prevailing on board this vessel, and that, whatever may be their technical legal liability, they and their executive agents share largely in the moral responsibility for the awful results of this disaster."

The report shows that the operations of the Steamboat Inspection Service at New York were unsatisfactory, inefficient, and negligent in many respects, and recommends thorough reorganization of the force of assistant inspectors. Referring to the work of the supervising inspector in New York the commission says:

"If he did not know of the facts of inefficiency and neglect on the part of his subordinates, or if he knew of them and did not take steps to remedy them, he is equally chargeable with neglected duty. But it is undeniable that the local board at this port did not do its duty. Upon the supervising inspector, therefore, must rest a large share of responsibility for the existence of such inefficiency and neglect."

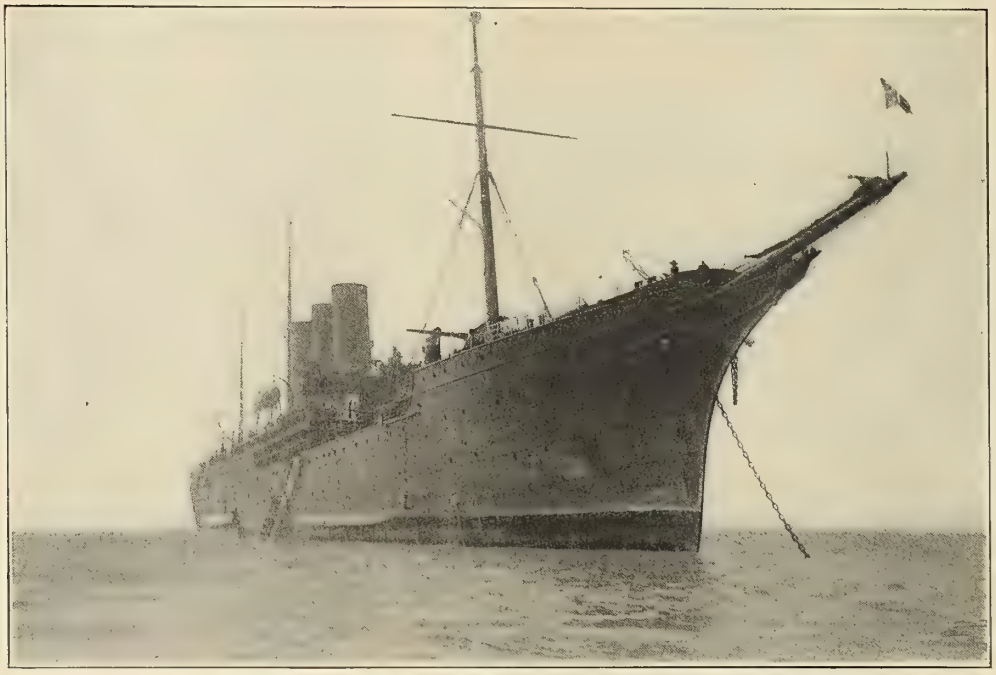
By reinspection of 268 vessels the commission has been able to analyze and consider with great care the actual condition of vessels in the Port of New York. In many instances since the *Slocum* disaster vessels have been re-equipped with new life-saving appliances and fire-fighting devices. The reinspection showed, however, the gross inefficiency of the old system of inspection, there being 33 per cent. of defective or missing life preservers, and 26 and 35 per cent. of defective or missing hose. The commission is of the opinion that the same state of facts applies to boiler inspection.

The commission presents many recommendations relating to the laws and regulations governing the Steamboat Inspection Service. It is pointed out that the present laws relating to safety appliances are inadequate and the commission strongly recommends that the laws relating to the service be amended so as to confer greater power to enforce its commands.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of October 12, 1904, the following degree of completion of vessels building for the United States Navy:

				Degree of Completion. Per Cent.	
BATTLESHIPS.				Sept. 1	Oct. 1.
Ohio	18 knots.	Union Iron Works		99	99.7
Virginia	19 "	Newport News Co.		66.8	68.6
Nebraska	19 "	Moran Brothers Co.		56.7	59
Georgia	19 "	Bath Iron Works		63.3	65.3
New Jersey	19 "	Fore River S. and E. Co.		66.4	69.1
Rhode Island	19 "	Fore River S. and E. Co.		68.9	71.2
Connecticut	18 "	Navy Yard, New York, N. Y.		50	53.59
Louisiana	18 "	Newport News Co.		56.5	59.68
Vermont	18 "	Fore River S. and E. Co.		16.3	21.5
Kansas	18 "	New York Shipbuilding Co.		22.1	26.6
Minnesota	18 "	Newport News Co		39.77	43.8
Mississippi	17 "	Wm. Cramp and Sons		7.71	10.24
Idaho	17 "	Wm. Cramp and Sons		7.47	9.98
ARMORED CRUISERS.					
Pennsylvania	22 knots.	William Cramp and Sons		86.7	90.5
West Virginia	22 "	Newport News Co.		91.62	94.2
California	22 "	Union Iron Works		63	64
Colorado	22 "	William Cramp and Sons		91.2	95
Maryland	22 "	Newport News Co.		89.16	90.57
South Dakota	22 "	Union Iron Works		61	61.5
Tennessee	22 "	William Cramp and Sons		45.74	50.06
Washington	22 "	New York S. B. Co.		41.4	44.7
PROTECTED CRUISERS.					
Chattanooga	16½ kts.	Lewis Nixon		94.62	97
Galveston	16½ "	Wm. R. Trigg Co.		89	91
St. Louis	22 "	Neafie and Levy Co.		48.8	51.1
Milwaukee	22 "	Union Iron Works		57	58.5
Charleston	22 "	Newport News Co.		81.4	83.2
GUNBOATS.					
Dubuque	12 knots.	Gas Engine and Power Co.		58.4	63.9
Paducah	12 "	Gas Engine and Power Co.		53.6	58.9
TRAINING SHIPS.					
Cumberland	Sails	Navy Yard, Boston		66	72
Intrepid	"	Navy Yard, Mare Island		49.1	56.2
TRAINING BRIG.					
Boxer	Sails	Navy Yard, Portsmouth		75	85
TORPEDO BOATS.					
Stringham	30 knots.	Harlan and Hollingsworth		99	99
Goldsborough	30 "	Wolff and Zwicker		99	99
Blakely	26 "	George Lawley and Son		99	99
Nicholson	26 "	Lewis Nixon		99	99
O'Brien	26 "	Lewis Nixon		98	98



RUSSIAN CRUISER LENA, OF THE VOLUNTEER FLEET, AT ANCHOR IN SAN FRANCISCO BAY.

[Photographs by Dana & Petersen.]

Cruiser Lena of the Russian Volunteer Fleet.

BY W. S. ATKINSON.

The cut herewith presented shows the Russian auxiliary cruiser *Lena,* Captain Berlinsky, which escaped the watchful eye of the Japanese at Vladivostok, and, it is reported, at the high speed of 19 knots steamed across the Pacific, entering San Francisco harbor September 11, 1904, saluting the forts and warships on her way to an anchorage off the Union Iron Works. The captain made the statement that he was obliged to come here owing to the bad condition of the ship's boilers. At first this was considered by many a strategic move to gain time in port, but a thorough inspection of the boilers by the local United States inspectors soon set aside all rumors as to the *Lena's* unexpected visit to the Golden Gate.

Orders were soon received to disarm the *Lena;* for this purpose the ship, escorted by the U. S. S. *Marblehead,* was taken to Mare Island navy yard, where all that went to make her offensive to Japan was safely stored in the government magazines. At present she is moored alongside one of the yard docks, which is patroled by U. S. marines, while a small launch protects her from all harm on the outboard side. No one is permitted to board her without her commander's consent.

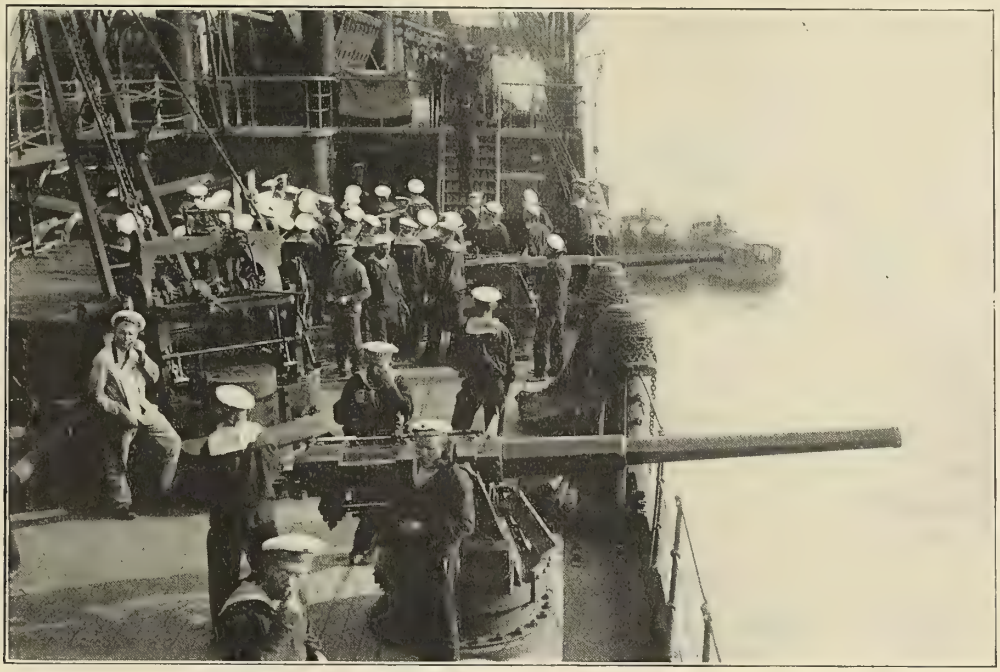
The *Lena,* formerly the steamship *Kherson,* was built for the Russian Volunteer Fleet Association of St. Petersburg, in August, 1896, by R. & W. Hawthorn, Leslie & Company, Ltd., Newcastle-on-Tyne. She is classified for Lloyd's highest rating and is known as a first-class twin screw passenger steamer, having three masts, schooner rig, with a maximum speed of 23 knots per hour. Some of her principal dimensions are as follows: Length over all, 493 feet; extreme beam, 54 feet; depth, 37 feet, and load draft, 24 feet.

When in the merchant marine service, accommodations are provided for 148 first-class passengers, 60 third-class passengers and 1,444 imigrants, a total of 1,652 passengers.

Power is furnished by two sets of triple expansion engines of the vertical inverted type, having three cylinders of the following diameters, 36, 57 and 92 inches. The common stroke is 54 inches. The Marshal type of valve gear operates all steam valves. There are two cast steel propellers 17 feet 6 inches diameter, 24 feet 6 inches mean pitch, and of 98 square feet projected area per wheel. Steam is supplied by 24 Belleville water tube boilers at a pressure of 250 pounds, reduced to 160 pounds at the throttle. The total heating surface is 35,300 square feet and the total grate area 1,130 square feet. The boilers are arranged in three watertight compartments of eight boilers each, and those of each compartment lead to a stack 96 feet high above the keel by 9 feet 6 inches diameter.

The vessel is illuminated throughout by electricity and provided with two powerful search lights. All quarters have artificial means of heating and ventilating. Extensive refrigerating and evaporating plants form some of the valuable auxiliaries to be found on modern ships. Her present armament consists of 15 rapid fire breech loading rifles of 120 millemeters caliber. The crew, consisting of 650 officers and men, still remain on board their ship, 24 being allowed shore leave each day.

There is much keen interest among San Francisco ship builders over the fact that the captain has been authorized to convert the ship into a modern transport, and make all repairs, alterations, etc., necessary to put her in first-class condition. Bids have been called for and all local yards are working night and day preparing plans, specifications, etc.



VIEW ON THE STARBOARD GUN DECK OF THE RUSSIAN VOLUNTEER CRUISER LENA.

The plans, as projected, require a complete rearrangement of officers' quarters, the fitting up of main and lower decks for the accommodation of 2,000 troops and 250 crew, the installation of new electric, heating and ventilating systems, new anchors, windlass, deck winches, search lights (in military tops), submarine lights, etc., 24 Belleville water tube boilers with uptakes, breeching, stacks, feed pumps and piping.

Going into the engine room the plans are even more extensive, calling for four new circulating engines and pumps, auxiliary condensers, feed water heaters, filters, auxiliary, steam and exhaust piping throughout, machine shop and the complete overhauling of main engines.

The new evaporating plant with distillers, pumps, etc., is to have a capacity of 50 tons boiler water and 30 tons drinking water per 24 hours. The present armament is to be replaced by 11 rapid fire breech loading rifles of 120 millimeters caliber, 12 of 75 millimeters, eight of 47 millimeters and 4 1-pound guns for military tops.

Magazines are to be fitted with complete flooding system throughout. No definite reason can be ascertained from the officers of the *Lena* why so much machinery is to be renewed or to the future movement of the ship after being converted into a transport.

THE ENGINEER'S FORCE ON THE LENA—THE CHIEF ENGINEER IS MARKED WITH AN X.

Quarterly Shipbuilding Returns.—The Bureau of Navigation reports 328 sail and steam vessels of 40,374 gross tons built in the United States and officially numbered during the quarter ended September 30 as follows: Wooden sail vessels, 130, of 24,363 gross tons; wooden steam vessels, 179, of 7,130 gross tons. Steel vessels constructed in this period are all fitted with steam power to the number of 19, of 8,881 gross tons. All but four vessels of 409 gross tons, which were built on the Great Lakes, were constructed on the Atlantic and Gulf. During the corresponding quarter of last year, 310 sail and steam vessels of 66,023 gross tons were built in the United States and officially numbered. There is a decrease of over 6,000 tons of wooden steam vessels, an increase of about 12,000 tons of wooden sail vessels, and a decrease of about 31,000 tons of steel vessels.

TEMPORARY DRY-DOCKS FOR RAPID CONSTRUCTION.*

BY V. E. TIMONOFF,[1] M. AM. SOC. C. E.

GENERAL CONSIDERATIONS.

As maritime commerce extends to the most remote regions of the world, the need of finding everywhere facilities for thorough repairs of damaged merchant vessels makes itself more and more felt. Many vessels have had to be abandoned because there were no facilities and appliances for their repair at nearby landing places. This happens less frequently with war ships, but even the navies of the world may sometimes be in need of repairs when far from harbors with special and permanent repairing facilities.

On the other hand, modern appliances for repairing ships are very costly and cannot be installed everywhere. It is therefore of interest to try to find whether the same object can be attained by more simple and less costly means, though less conveniently than with perfect facilities.

It is the object of this paper to indicate one of the possible solutions of this problem. The method proposed by the writer seems to him to promise satisfactory results should local conditions permit its application.

REPAIRING SHIPS IN HARBORS PROVIDED WITH DOCKING FACILITIES.

In commercial or military ports various means are used for important repairs to floating ships, for scraping the hull, for repainting, etc., according to each case, and, especially, according to the dimensions and importance of the vessel. They are accomplished either by heaving the ship down or grounding it on a keeling dock, by raising it on a lifting slip, by towing it into a repairing or floating dock, or, finally, by lifting it by an elevating apparatus. The appliances for repair most generally used and best adapted to vessels of all dimensions are dry-docks. They consist, as is well known, of fixed basins, which can be emptied and so maintained after the vessels have been brought into them. The construction of dry-docks generally presents serious difficulties because of the pressures to be sustained and the tightness required.

A stiff floor and side walls are built, which form on the inside a succession of banks or steps to facilitate the propping of the vessel. Stairways and slideways are provided for the easy access of the workmen and materials. Capstans, mooring posts, tackle and all kinds of appliances are placed to allow of easy handling of vessels and caissons, and, finally, derricks are arranged for managing heavy pieces such as screws and shafts.

The water in the dock, whether due to infiltration or filling, is collected in drains and led by conduits into drain wells, from which it is pumped into the sea. The ships in the dock rest on keel and bilge blocks and are supported by props and shores. To allow space for the rudder while the vessel is in the dock, a pit, called the rudder pit, is frequently made in the floor.

The location of docks is so determined that vessels may be able to enter with safety and security, as the operations of entering and leaving, especially with large ships, are quite delicate. The docks are, therefore, placed not far from the quays where the ships are usually stationed.

Dry-docks, entrances to which are not provided with mitered gates, are closed either by floating caissons or by caissons rolling on the floor of the dock. A floating caisson acts as a movable and tight screen, which can be floated to uncover the opening it closes, and which can be raised and lowered by admitting water into the floating chamber. It is brought into the dock and depressed before the dock is drained; after the emptying of the latter it is raised by discharging the water used in lowering.

The writer has enumerated the principal features of an ordinary dry-dock to show in a stronger light the simplifications which he proposes for temporary dry docks.

REPAIRING SHIPS WITHOUT DOCKING FACILITIES.

If the repairs to be made on a ship are not very considerable, and if the damaged parts are not too far from the line of floatation, the repairs can sometimes be made successfully while the ship is afloat.

By displacing the ballast on the vessel the damaged portion can be raised above the surface of the water and the repairs be made. This method is applicable within very narrow limits only, so much the more so since an unsymmetrical load on large vessels, especially on war ships, is often dangerous and may cause their overturning.

Sometimes it is possible to surround the damaged part by a floating caisson which fits snugly against the sides of the vessel and permits of keeping the place to be repaired partly dry. Work in such caissons is naturally slow and inconvenient. The limited dimensions of the caisson do not permit the easy introduction of plates. Besides, the shape of certain parts of a vessel does not lend itself to the use of a floating caisson, and, if the damaged parts are deep, the pumping becomes very difficult, if not impossible.

Finally, the building of the caisson itself is complicated, laborious and slow work.

In tide water unimportant damages can be repaired by stranding the ship on a sand bank at high tide and so exposing part of the vessel at low tide. This method is applicable only when the damaged part is located between the high and low water levels.

Without proceeding further to examine the various expedients which may in certain cases give good results and not be applicable in others, it must be admitted that the universal method which is able to meet all conditions is the dry-dock. By giving access to all parts of the vessel it makes possible the concentration of a great number of workmen at the place of damage, permits the handling of plates and other parts of all dimensions, and, finally, insures continuous and safe work.

NECESSITY FOR RAPID CONSTRUCTION OF TEMPORARY DRY-DOCKS.

The somewhat hasty examination of methods employed in repairing ships afloat will, however, suffice to show the necessity there may be for the rapid construction of temporary dry-docks, in the interest of the merchant marine as well as of war vessels. With this in

[1] Professor at the Institute of Ways of Communication at St. Petersburg, Russia.

*Paper read before the International Engineering Congress, St. Louis, Mo., October 3 to 8, 1904.

view, all indispensable work must be reduced to a minimum, and any parts of a dry-dock existing in one form or another in the given locality must be utilized to the fullest extent.

If a natural or artificial basis can be found where the dry-dock can be located, the excavation of a special basin may be dispensed with. If pumps are available sufficiently powerful to maintain the dock in a condition dry enough for continuous work in spite of more or less considerable infiltration, it will not be necessary to secure a perfectly impermeable floor and side walls, and the least required tightness will suffice.

It will be unnecessary also to surround the dock with walls more or less vertical so that walls of loose stone only, without mortar, may be used, which can be laid in place by unskilled labor and by means of cars and boats. The blocks, which in the ordinary dry-dock support the weight of the vessel and require a very solid foundation to transmit it to the ground, can also be omitted, as will be shown later. Finally, the floating caisson may be replaced by a gate of a rougher kind and easier construction.

The problem of building a temporary dry-dock, undoubtedly, has several solutions for each special case encountered by the engineer, and it is far from the intention of the writer to enumerate all methods by which a dry-dock can be rapidly constructed. As stated above, he merely desires to indicate a method proposed by him for a particular case and which appears to be extremely simple and cheap.

A PROPOSED SYSTEM OF TEMPORARY DRY-DOCKS FOR RAPID CONSTRUCTION.

The fundamental idea of the system of temporary dry-docks proposed by the writer is based on the reservoir dams as built of loose stones in California. These dams, as is well known, have been invented by practical men without technical training but gifted with the genius of their race. The pioneers of civilization in the gold mining states needed great stores of water. To build dams in the rocky gorges of the mountains nothing but stone was available. The use of mortar for binding the stones together was impossible because of the lack of cement and skilled labor. It was then attempted to build reservoir dams of stones thrown on the ground as riprap without mortar and, from the point of view of rapid work, cheapness, and strength of the dams, remarkable results were obtained. A dam 210 feet high, exceeding in height the greatest dams built of masonry laid in cement mortar, is now being built of loose stone in California. The possibility of building walls of loose stone, able to resist such high water pressures, enables us also to use this method of construction for dry-docks.

In an existing basin, or near a shore sheltered from the waves, or finally, in a recess of the ground, an enclosure is made by means of a dike of loose stones. Figs. 1 to 4 indicate the different cases which may occur according to local natural or artificial conditions. This dike consists of a stone prism and is covered from the outside with a layer of earth to increase its tightness. Such a dam, compared with any other kind, has the following advantages:

1. *Rapid Construction.*—The stones are dropped just as they are brought to the work without sorting and without mortar, and, as they can be transported in cars or boats, the working space can be enlarged almost at will and the number of workmen, who may be unskilled laborers, may be correspondingly increased. A speed of construction is obtained with such a loose stone dam which cannot be reached with any other materials. If, for instance, the dam had to be built of sheet piling and stones, timber of large dimensions and special pile drivers would be required; it would further be necessary that the ground should permit the driving of sheet piling all around the dam, and, if all these conditions were fulfilled, rapid work could not be done without risking the tightness of the work.

2. *The Tightness of a Loose Stone Dam can be Progressively Increased According to the Needs.*—A loose stone dam covered with a layer of earth can be made tighter by simply increasing the thickness of the protective layer. In all other systems the dam must from the start have such dimensions as will secure the necessary tightness, which leads to exaggerated dimensions which cannot be determined from the beginning. A loose stone dam covered with earth is built of the least dimensions, and afterwards, according to the indications of its workings, the thickness of the earth layer can be increased, if required, without exceeding the necessary limits.

3. *Easy Removal.*—To remove a loose stone dam or to make an opening in it, unskilled laborers supplied with wheelbarrows for the upper portion and a dredge for the lower will suffice. Into the enclosure made by a dam as described and having a sufficient depth of water a vessel can be floated through an opening left in the dam for this purpose. This opening is then closed in the way the dam was built or by more perfect means.

A pumping station located on the shore or on the dam will accomplish the draining of the dock and the lowering of the vessel. To protect the hull from damage which may be caused by resting the vessel on the ground, a deep layer of sand is deposited on the bottom of the dock. This layer of sand replaces the blocks of the ordinary dry-dock. As the water falls, due to the action of the pumps, the vessel gradually compresses the sand and thus prepares the bed for supporting its weight. This is distributed with much regularity over a very great area.

Actual experience in stranding war and merchant vessels of high tonnage on sand banks exposed at low tide, to make urgent repairs, has proved that the strength of the hull is not impaired by this expedient. This has not been tried with large modern vessels of more than 10,000 tons displacement, but even for vessels of such dimensions there is no reason to expect that serious trouble will be caused by their resting on a layer of sand instead of a series of blocks. Such trouble will be of small importance since the repairs generally required are not far from the line of floatation. It will, therefore, not be necessary to drain the dock completely; it will suffice to simply lower the water level enough to uncover the damaged part. The sand foundation will thus, in such cases, have to sustain only a fraction of the weight of the vessel. For damages located deeper, it may be equally unnecessary to drain the dock completely, but it may suffice to lower the water level enough to make it possible to build around the damaged spot a sand dam and then to drain this secondary enclosure.

To float the vessel out of the dock after repairing, an opening is made in the dock of sufficient size to let the vessel pass. In a dam of loose stone and earth this work is very simple. The method of procedure has been indicated above. The amount of material to be removed can be reduced to a minimum by floating the ship out at high water. Had the dam been built of piles and sheet piling, these would have to be removed for their full height without being able to utilize the advantages of a high tide. The dam can easily be closed for new repairs.

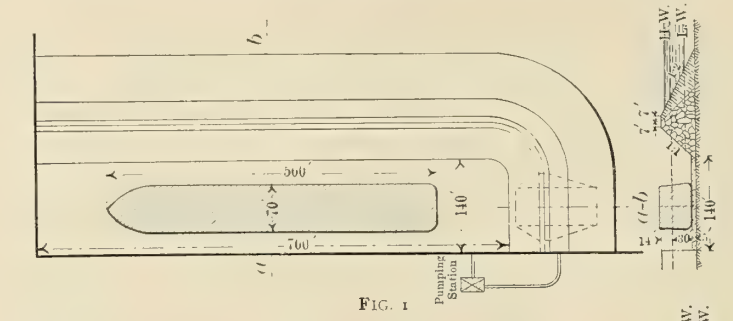


FIG. 1

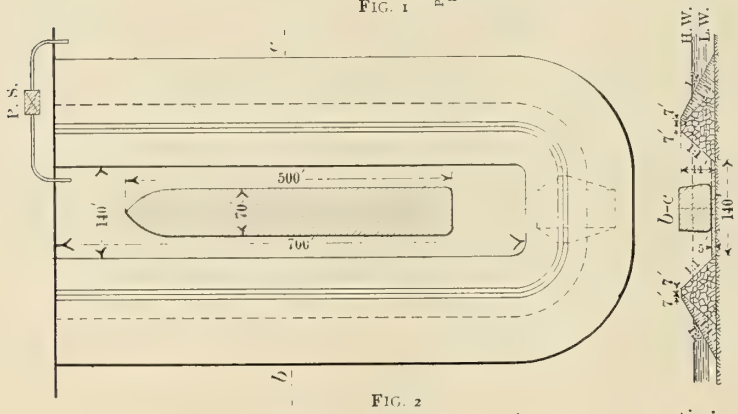


FIG. 2

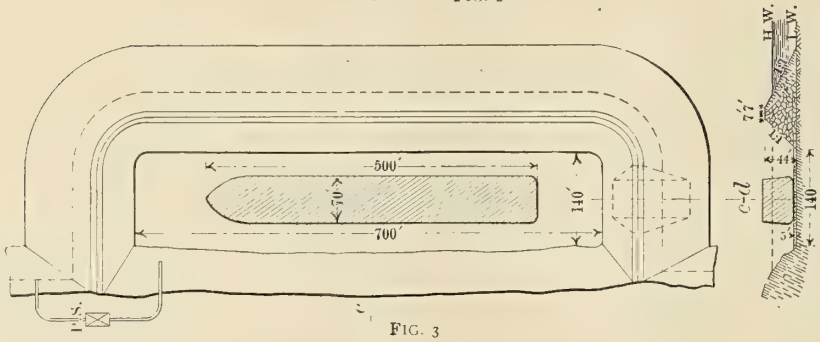


FIG. 3

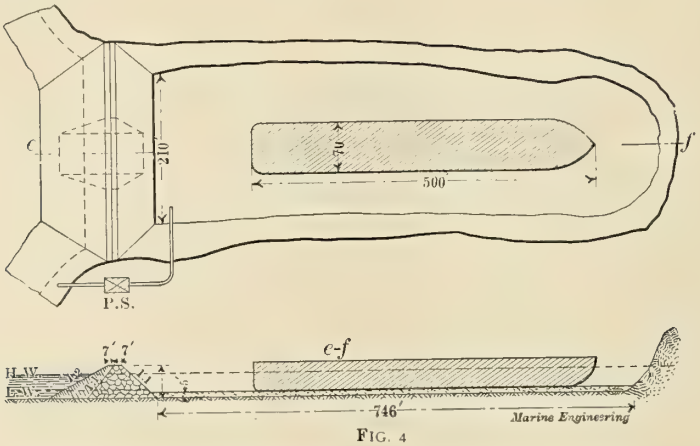


FIG. 4

PROPOSED FORMS OF TEMPORARY DRY-DOCKS THAT CAN BE RAPIDLY BUILT.

If the temporary dock has to be used frequently enough, and if sufficient time is available to build a more perfect gate, this can be done while the dock is in use. This object could be attained, for example, by the

construction of a gate with the aid of wooden caissons. It can be built in a separate place and rapidly be put into position without stopping the work in the dry-dock for a long time. To close the entrance of the dock, a boat of convenient dimensions may be adapted, which, while not being as perfect as a real floating gate, will much facilitate the handling of the opening and closing of the dock and still give sufficient tightness.

As a final improvement a floating or rolling dock gate may be built, and, should it be found necessary, blocks to support the weight of the vessel may be built on special foundations.

APPLICATION OF THE PROPOSED SYSTEM.

The temporary dry-dock for rapid construction, proposed by the writer, consists, as described in the above, of an enclosure made partly by the shore, natural or artificial, and partly by a dam of loose stone and earth. It can be emptied and kept dry by a pumping station working continually, if required. The function of the keel blocks is performed by a deep foundation layer of sand. The opening through which the vessel is floated into the dock is closed by a fill of loose stone and earth which is afterwards removed by simple means to let the repaired vessel out. A dock of such construction can be improved further without stopping the work in the dock.

The successful application of this system of construction depends on the character of the ground. If the ground is too permeable, if it is a fissured rock, and if, therefore, the natural bottom of the dock may be liable to very considerable infiltration exceeding the pumping capacity, the difficulties to be overcome are very great. But in the majority of cases the same conditions will be encountered, as far as pumping is concerned, as in the sinking of large trenches, and the success of the enterprise cannot be endangered.

The location of the dock should be so chosen as to make the perimeter of the dike and the amount of work to be done as small as possible. If the shore forms a bay in which the water is deep enough or can be easily deepened it will preferably be chosen. (See Fig. 4). If not, there may be a corner of a floating dock (Fig. 1), or a site near a sheltered shore. These conditions are, however, of a character which cannot be generalized. Tides can facilitate the use of the proposed system by making possible considerable reduction in the volume of the dam to be removed to let the vessel out after repairs have been completed.

CONCLUSIONS.

Merchant vessels are always and war vessels are sometimes in need of repairs of damages sustained by them far from ports provided with all modern facilities for docking and repairing. A dry-dock is the most convenient appliance for repairing. Means should be devised to construct dry-docks rapidly and cheaply with materials which may be at hand at localities distant from the centers of production. The dry-dock system proposed by the writer, consisting of a dam of loose stone and earth and a sand foundation replacing the blocks, seems to fulfill, for local conditions where it is applicable, the requirements of quick construction, simple work and cheapness, while it procures for vessels the facilities to make all necessary repairs.

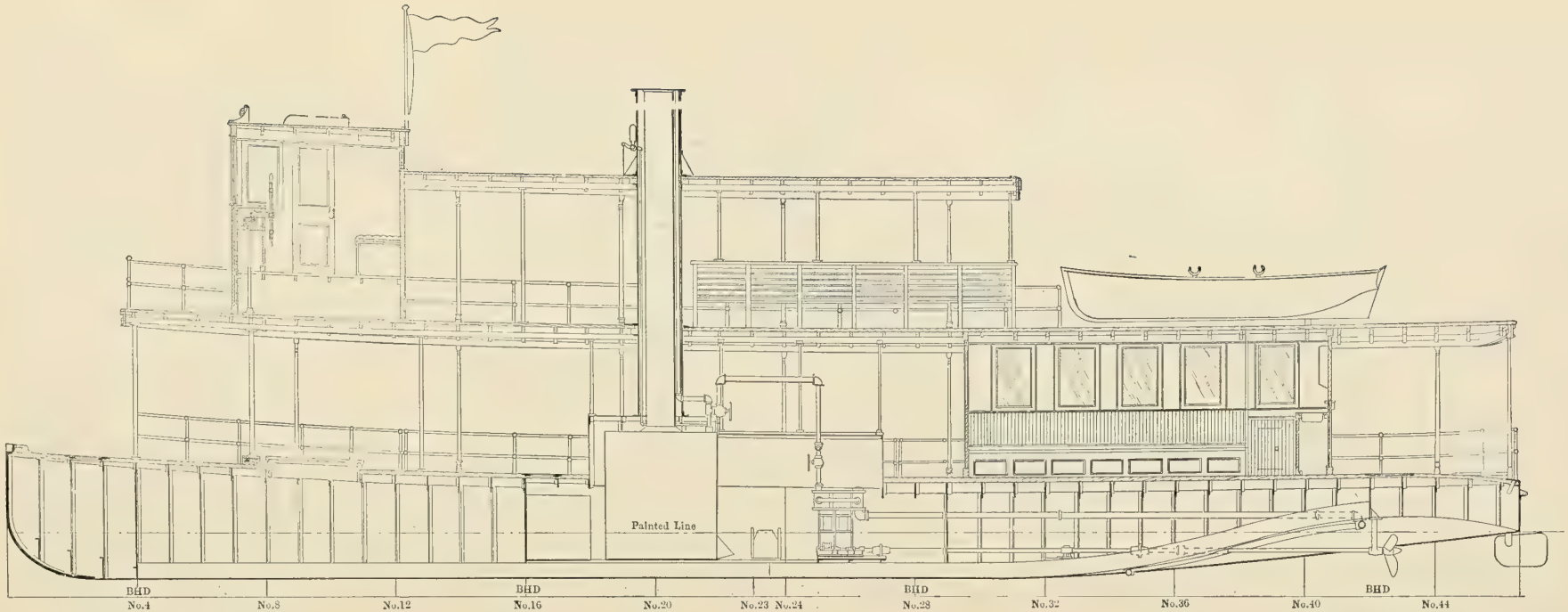
Wreck of the Drumburton.

The fine four-masted British ship, the *Drumburton*, recently ran on a reef during a fog on the California coast, and though she went ashore while light, and there was little wind blowing, she settled so securely on the rocks that it is impossible to save her.

BRITISH SHIP DRUMBURTON, AGROUND OFF POINT SAN PEDRO, CAL.

On September 3 the *Drumburton* left San Francisco in ballast bound for Puget Sound to load cargo for Valparaiso. When she had passed out of the Golden Gate the fog closed in and a treacherous sea carried the ship on the sharp rocks of Point San Pedro, 10 miles south. The bottom was punctured in several places, and the ship settled quickly into a saddle of rocks from which nothing but the storms of winter will ever dislodge her. All that may be saved are the sails, rigging, and other probable equipment.

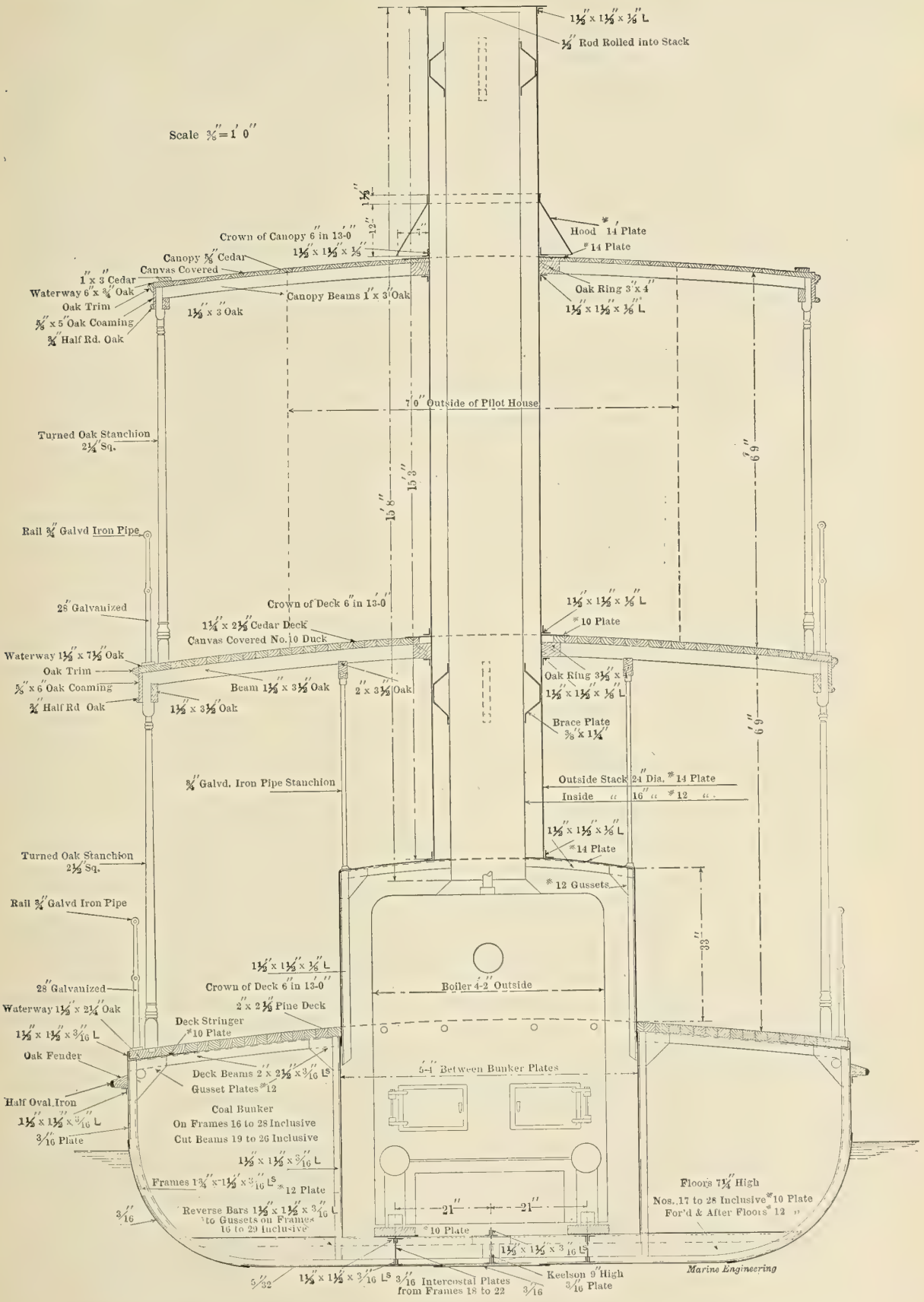
Great Lakes Shipbuilding.—During the past month orders for 21 new, large ships have been placed with the yards on the great lakes.



INBOARD PROFILE AND DECK AND HOLD PLANS OF THE NEW SHALLOW-DRAFT TUNNEL PROPELLER STEAMER MACUSPANA.

Shallow Draft River Boat Macuspana.

The opening up of new country to navigation by means of shallow draft river steamers is creating a good demand for this type of vessel. The Racine Boat Manufacturing Company, Muskegon, Mich., has just completed the designs and is now carrying on the construction of a 70-foot twin screw vessel of this class, for Mr. Ignacio Carrenza of Mexico, for service on the Macuspana river. The draft is limited to 26 inches when loaded with 15 tons freight and fuel. The hull is built very light—the lightest consistent with strength—and abaft is in the form of a tunnel for placing the


1½" x 1½" x ⅛" L
⅛" Rod Rolled into Stack
Scale ⅜"=1' 0"
Hood * 14 Plate
* 14 Plate
Crown of Canopy 6" in 13-0"
1½" x 1½" x ⅛"
Canopy ⅝" Cedar
Canvas Covered
1" x 3" Cedar
Waterway 6" x ¾" Oak
Oak Trim
⅝" x 5" Oak Coaming
¾" Half Rd. Oak
Canopy Beams 1" x 3" Oak
1½" x 3" Oak
Oak Ring 3" x 4"
1½" x 1½" x ⅛" L
7' 0" Outside of Pilot House
Turned Oak Stanchion 2¼" Sq.
15' 8"
15' 3"
6' 9"
Rail ¾" Galvd Iron Pipe
28" Galvanized
Crown of Deck 6" in 13-0"
1¼" x 2⅝" Cedar Deck
Canvas Covered No. 10 Duck
1½" x 1½" x ⅛" L
* 10 Plate
Waterway 1½" x 7½" Oak
Oak Trim
⅝" x 6" Oak Coaming
¾" Half Rd. Oak
Beam 1½" x 3½" Oak
2" x 3½" Oak
1½" x 3½" Oak
Oak Ring 3½" x 4"
1½" x 1½" x ⅛" L
Brace Plate ⅜" x 1¼"
¾" Galvd. Iron Pipe Stanchion
Outside Stack 24" Dia. * 14 Plate
Inside " 16" " * 12 "
1½" x 1½" x ⅛" L
* 14 Plate
Turned Oak Stanchion 2½" Sq.
* 12 Gussets
Rail ¾" Galvd Iron Pipe
33"
1½" x 1½" x ⅛" L
28" Galvanized
Crown of Deck 6" in 13-0"
Boiler 4-2" Outside
Waterway 1½" x 2¼" Oak
2" x 2½" Pine Deck
Deck Stringer
* 10 Plate
1½" x 1½" x 3/16" L
Oak Fender
Deck Beams 2" x 2½" x 3/16" LS
5-4" Between Bunker Plates
Gusset Plates * 12
Half Oval Iron
1½" x 1½" x 3/16" L
3/16" Plate
Coal Bunker
On Frames 16 to 28 Inclusive
Cut Beams 19 to 26 Inclusive
1½" x 1½" x 3/16" L
Frames 1¾" x 1½" x 3/16" LS
* 12 Plate
Reverse Bars 1½" x 1½" x 3/16" L
to Gussets on Frames
16 to 29 Inclusive
3/16"
21"
21"
Floors 7¼" High
Nos. 17 to 28 Inclusive * 10 Plate
For'd & After Floors * 12 "
* 10 Plate
1½" x 1½" x 3/16" LS
5/32"
1½" x 1½" x 3/16" LS
3/16" Intercostal Plates
from Frames 18 to 22
3/16"
Keelson 9" High
3/16" Plate
Marine Engineering

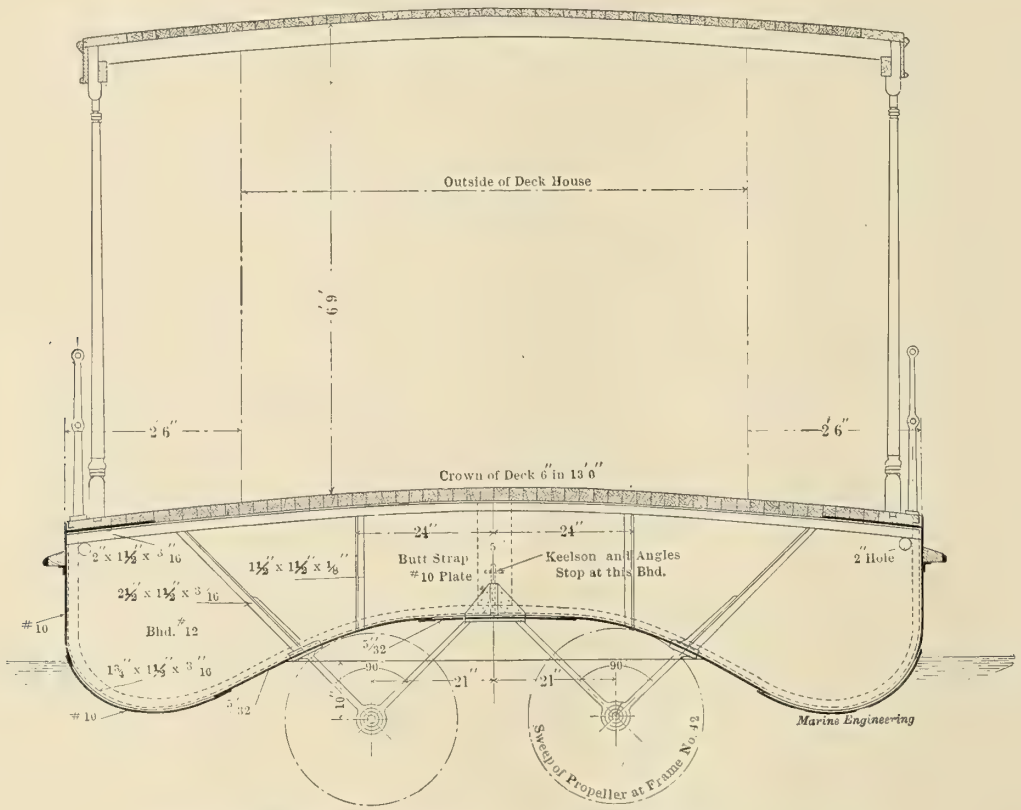
MIDSHIP SECTION OF SHALLOW-DRAFT STEAMER MACUSPANA, BUILT BY THE RACINE BOAT MANUFACTURING COMPANY.

propellers and giving them a free run of water. There are four transverse water-tight bulkheads on frames No. 4, 16, 29 and 42, the latter being the location of the propeller struts. These bulkheads divide the boat into five self-contained sections, each of which is to be built to ship independently ready for assembling in Mexico. The machinery is placed midships with deep coaming about hatch, but not inclosed. The space forward and abreast the machinery is available for cargo, and aft is placed a saloon fitted with extension berths and a galley and toilet. The forward hold is available for freight, while on either side of the boiler are coal bunkers with a cubic capacity of nearly 300 feet.

The scantlings of the boat are well shown in the plans. The dimensions of the hull are: Length, 70 feet; beam, molded, 13 feet, over fenders, 14 feet; draft, loaded with 15 tons, 26 inches.

The hull is built of steel throughout; all plating is galvanized. Fore and aft seams are lapped and single riveted, while thwartship butts are double riveted with butt straps on the inside.

The machinery consists of a pair of fore-and-aft high speed engines, with cylinder diameters 4 1-2 and 9 inches and with a stroke of 6 inches. The piping is so arranged that either engine may be worked independently, but they both may be worked together by means of a throttle valve and auxiliary throttle. Piston rods, connecting rods and valve rods, eccentric rods, etc., are to be of best mild steel. The crank pin brasses, crosshead brasses and the reverse connections are to be of hard bronze metal. When running full power the engines will indicate 50 horse power. The condenser is of the Racine improved sectional type, hung on the tunnel bottom as shown on the drawing, page 518. An independent air pump is fitted: the feed pump is of the simplex vertical type. The propeller wheels are of a naval composition and the struts and stern tubes of naval bronze. A Racine boiler with 12 square feet of grate surface and 325 square feet of heating surface, designed for a working pressure of 225 pounds per square inch, is to be installed. All the pressure piping is of heavy steel and all valves are to have bronze bodies and of extra heavy pattern where necessary. The other equipment includes bilge pump, injector, firing tools and special wrenches, and all fittings are for salt water service.



SECTION AT BULKHEAD 42, ON THE MACUSPANA, SHOWING TUNNEL AND PROPELLERS.

Russian Cruiser Askold.

After the naval battle of August 10 between the Russian and Japanese fleets off Port Arthur, the Russian cruiser *Askold* sought refuge in the friendly port of Shanghai, China. The condition of this ship as she was moored in the Whangpo river is illustrated by engravings made from photographs taken at the time. In the full view is shown the general damage to the entire upper works of the ship. At the point on the water line directly above the cross is an opening made by a 6-inch armor-piercing shell. The manner in which the superstructure was riddled by the exploding of a 6-inch shell is shown in the nearer view of the launch. The hull was pierced through and through above the water line by several heavy shells, most of which created fearful carnage and destruction.

RUSSIAN CRUISER ASKOLD, AT ANCHOR OFF SHANGHAI, AFTER THE BATTLE OF AUG. 10.

RUSSIAN CRUISER ASKOLD, SHOWING THE DAMAGE TO DECK AND LAUNCH, RESULTING FROM THE EXPLOSION OF A SHELL.

[Photographs from Leslie's Weekly.]

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PROF. W. F. DURAND, Advisory Editor.

FREDERICK D. HERBERT, Editor.

GEORGE SLATE,
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Notice to Advertisers.

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AT last, after many official dates for the sailing of the Russian Baltic fleet have come and gone without the vessels appearing on the high seas, it is announced by cable that the fleet is about to pass through the Sound of Denmark into the North Sea and proceed to the Far East. The ships comprising this fleet are a mixture of the new and the old, some of them the pride of the Russian navy. Briefly stated, they consist of seven battleships, the oldest one launched in 1891 and the latest launched in 1902. The armament of six of these battleships consists of four 12-inch guns and one of them of four 10-inch guns. The second piece of the primary battery is a 6-inch gun, twelve of them being fitted on each of the four newest vessels and eight, six, and eleven guns of this caliber being mounted on the remaining ships. The cruisers are of the smaller class, the largest as well as one of the oldest being of 8,500 tons displacement. Compared with the naval force which Japan may oppose, Russia is superior in gun power. However, the uniformity of the Japanese fleet, the remarkable training in war, the unapproachable discipline, the brilliant record of successful engagements, will throw the balance of power in favor of Japan. In addition Japan is fighting in her own waters, near her base of supplies, while the Russian fleet may be intercepted before it reaches a Russian port, and at the end of a 14,000-mile journey sadly in need of repairs.

It is stated that the fleet will be divided and proceed to some point of rendezvous in the Indian ocean by two routes, the larger ships by way of Cape Good Hope and the smaller vessels, including the torpedo boat squadron and the small gun boats, by way of the Suez canal. Each fleet will be accompanied by several colliers, supply, and repair ships, and already thousands of tons of coal are under way for use en route. Several of the Hamburg-American steamships have been chartered for this purpose. The speed of the fleet, of course, is that of the slowest vessel, and it is doubtful if the trip can be made at an average of over 10 knots, which, with the unavoidable delays for coaling and repairs, means that the voyage will take about ninety days. Arrangements have been completed, it is reported, through French authorities, to permit the squadron to take on board at Seignon sufficient coal to carry to the nearest Russian port, namely, Port Arthur or Vladivostok.

The final destination of the fleet forms the greatest source of conjecture. Assuming that General Stoessel is still in command at that time, it is probable that the Baltic fleet will sail directly for Port Arthur, to join the remnant of the once splendid Russian armada in that harbor. This juncture would, indeed, prove serious to the Japanese, and it is probable that their command of the seas would be lost. Another possibility is that the Russians will sail directly to Vladivostok for necessary repairs and replenishing before taking to sea for battle. This harbor becomes ice bound in December, but if necessary, a channel will be kept open. It is doubtful if Admiral Togo could spare sufficient of his fleet from Port Arthur to intercept the Russians while he has to maintain the blockade of that port. The Russians would thus be in a position to prey most seriously upon Japanese commerce, and to devastate the coast, chosing their own time to attack the Port Arthur squadron.

These, however, are improbable possibilities, in that all signs point to the speedy reduction of Port Arthur, and especially under the pressing danger of the coming fleet Japan would, if necessary, direct her entire energies against the reduction of that stronghold. It appears impossible that the

fort can hold out for three months longer under these conditions. Also, the raising of the siege by the Northern army now appears a forlorn hope. Therefore, it will be possible for Admiral Togo to attack with his entire squadron the Russian fleet in the open seas, and to minimize its fighting capacity by destroying or capturing as many vessels as possible. He cannot expect to annihilate the entire fleet, as such an exploit is unknown in naval annals, and the escaping vessels would probably reach Vladivostok.

From our point of view this last naval move of Russia appears to be a desperate one, much like the despatch of Admiral Cervera to Cuba, and soon Russia may be relegated, temporarily at least, to a third-class naval power.

BY President Roosevelt's action on the report of the United States commission of investigation upon the *General Slocum* disaster the supervising inspector and the two local inspectors of the Port of New York have been dismissed from the service, and he has instructed that a thorough investigation of the United States Steamboat Inspection Service be undertaken at once. This service has for a long time been looked upon as one of the weakest in the government, principally due to the fact that congressional laws which created it and defined its scope of action were enacted many years ago, at a time when marine engineering was practically in its infancy. While the Board of Supervising Inspectors may recommend changes in the rules, and the Secretary of Commerce and Labor has authority to incorporate such changes, amendment of the statutes can only be secured by national legislation. Bills have been introduced in several sessions of congress giving power to revise this service, and shipping interests have worked hard to secure such legislation, but with no avail; the same laws are still in force. It is impossible to have an efficient system based on inefficient, antiquated laws. The commission's report is full of suggestions of necessary changes in the Steamboat Inspection Service, changes which have before been pointed out many times; however, the present recommendations, following close in the wake of the awful calamity of the summer, will, it is to be hoped, finally rouse congress to its responsibility for the present state of the service. A sad condition of affairs it is, indeed, which requires such a sacrifice of human life to bring about necessary reform.

The personnel of the Steamboat Inspection Service is not what we should desire. In the first place, the force of inspectors in New York is numerically too small to handle the regular work of inspection in any thorough and efficient manner. Again the inspection has been carried on, under directions from the head of the service, entirely by assistant inspectors, whose standing is an indefinite one at best. The local inspector must sign his subordinate's report, and thereby place himself responsible for the inspection, concerning which he has absolutely no personal knowledge. Again, under existing statutes, the inspectors have no power after condemning faulty or inefficient outfit to see that it is destroyed. Power should be given them to revoke a vessel's certificate at once on discovering any violation of the steamboat inspection law. The above are but a few of the many apparent defects in the statutes, but those which appear most conspicuous as contributing toward the *Slocum* disaster. Concerning the inadequacy of the rules governing boilers and machinery we have frequently drawn attention in these pages, and will not repeat, although the incongruous features become more glaring each year. We keenly regret that the individual has been held responsible for the workings of an absolutely inefficient law, and that the supervising inspector of New York has been removed.

IT is a pleasure to present to our readers on another page Rear-Admiral Melville's views on triple-screw propulsion. As engineer-in-chief of the United States navy the admiral for many years contended for triple screws in high-powered war ships. He keenly perceived the structural and strategic advantages of the triple screw, and the sessions of the Board of Construction were taken up with many a contention for and against this type, with the sturdy admiral in its favor. Under Secretary Tracy he was successful in so far as securing its adoption for the two commerce destroyers *Columbia* and *Minneapolis*. However, he was defeated in his desires to make the adoption general. The action of Germany, as the result of competitive manœuvring trials with twin-screw and triple-screw vessels, to adopt the triple screw in all future designs, and also the incidents of the present war in demonstrating the vulnerability of a ship's propeller and steering gear when under the enemy's fire, will doubtless determine other powers to adopt the triple screw. It has been used almost altogether in British turbine vessels, so that the one-time prejudice against it is now gone.

Freedom of the Seas; Unusual Adventures of a Merchantman.

BY E. A. SUVERKROP.

We were lying stern on to the long mole at Palermo, Sicily, loading oranges and lemons for the London market. On our starboard side was moored the *St. Asaph,* of London, and on our port the *Excellent,* of Sunderland. The latter had finished loading below and was taking on a deck load of oranges and lemon peel in barrels.

I was leaning over the taffrail, kidding the second engineer of the *Excellent.* "What idiot gave the name of *Excellent* to that old coal coffin? Where are you bound this trip?"

"We are bound for Philadelphia," he replied, ignoring my first question.

"You'll never pass the capes" (Gibraltar), said I.

Well, the next day a dapper little official came on board and tacked an elaborate document in Italian on our foremast, which turned out to be an arrest; the ship was held with a perishable cargo, pending the result of the legal proceedings.

Our old man (he was part owner) swore long and loud at the delay, but he was a man of more than words, as I well knew. He had been a blockade runner during the war between the north and the south, and later had run arms and ammunition to a dozen South American countries in times of revolution.

All the morning the winches rattled merrily away stowing the last cases below, and by 2 o'clock the loading was done and the hatch covers were on. Owing to the leaky condition of the donkey boiler we had steam on the one main boiler to supply power for the winches.

About 6 o'clock the skipper came on board and at once sent for the chief engineer. After a talk with him the second was sent for; the interview with him over, I, the third, was requested to lay aft. When I reached the cabin the old man motioned me to a seat and began.

"Mr. Suverkrop, you may not know it, but I am part owner of this craft, and every day we are kept in this port means money out of my pocket, which I can ill afford; our cargo is perishable, and I am liable for my share. We have been arrested, as you know; the charge is merely a blackmailing scheme, and by the time it is settled in court the cargo will be rotten and I will be ruined. I have been very busy to-day forming my plan of action. I suppose you know I have just had the chief and second here; they have both refused to take the vessel out to-night. Do you know how to handle the engines?"

"Yes, sir, I do," I replied.

"Will you take her out to-night at midnight?"

"I will, sir, if you give the orders. I know there is only one captain to one vessel (which is a wise provision of providence), and if you pass the word, it is you who will have to stand by the consequence, good or bad."

"Well spoken, and if we come out of this all right I will make you a present of a twenty-pound note. I want you to be ready at midnight, with every ounce of steam the boiler will carry. The warps astern will be cut and we will then have a clear, straight course out into the Mediterranean. We may be chased; there is a dirty little dago gun boat about, but as she can only steam 8 knots to our 9 I think we can shake her off before she does us much damage. Go now and get ready, for I rely on you alone as far as the engine room is concerned."

Fame had come at last, so off I trotted well pleased with my new rôle. Thinks I: "Suverkrop, old man, if you keep on in the straight and narrow path of virtue you may yet be hanged for pirarcy on the high seas."

My first job was to take the clappers out of the bells of the engine-room telegraph, both below and on the bridge. This done I had the four fires cleaned, went into the bunkers, sent down enough coal to last one watch, and had a lot more run over to the doors, so that it would not be necessary for the coal passers to go into the bunkers for 24 hours at least. By 11 P.M. I had good big fires in all the furnaces, 55 pounds of steam on the gauge (she blew off at 60), and had started to warm the engines up.

The engine-room skylights had been closed and covered with a double tarpaulin to keep the lights in the engine room from being seen from the shore.

At a quarter to twelve the old man came below.

"How are things, Mr. Suverkrop, are you all ready?"

"Everything is ready, sir, and the sooner we get out so that I can lift the skylights the better; we can hardly breathe down here."

"Well, be ready for 12, sharp. Good night."

At 11:59 the pointer on the engine-room telegraph wagged silently to and fro and stopped at "stand by." I answered promptly and ordered the ashpit dampers off and the furnace and smoke-box doors closed. This done the telegraph moved to "full ahead." At a sign from me the man on the boiler top opened the main stop valve full, while I opened the throttle a little at a time and round came the cranks, faster and faster. The old engine seemed like a thing of life, to enjoy the unusual sensation of having all the steam it could take care of.

I leaned back against the bulkhead under the ventilator to catch a breath of air; above the throb of the engines and the rattle of the fire irons in the stoke hold I could hear the sounds of the men on deck, and suddenly the dull boom of a gun borne on the night wind. Then the voice of the second mate shouted down the ventilator, "Give her all you can, Mr. Suverkrop; we are being chased, but so far their shooting is pretty wild."

The sound of the guns became more frequent but fainter as we outdistanced them, and at length the mate again called down, "You can lift the skylights now, sir."

So we steamed on down the African coast, intending to drop in at Orau, in Algeria, to coal, for we were short when we left Palermo. However, when we got abreast of Orau the chief told the skipper we had enough coal to take us to Gibraltar, where we could get our supply much cheaper. So we stood off to the northwest for Gibraltar.

We were due to reach there about midnight, and when I went on watch at that hour, for the middle watch from 12 to 4 is usually allotted to the third engineer, the loom of the lights of Gibraltar could be clearly seen in the sky to the northwest. The chief, whose watch preceded mine, told me we would get into Gibraltar about 2 A.M., and that he was going to set away the fire in the donkey boiler on deck, which had been repaired during our run up the coast.

The old man had been into Gibraltar many times and would run in without the aid of a pilot. As I stepped from my room to the engine room I noticed the lights of a small steamer a mile or so on our starboard quarter. I went below, and about 2 A.M. the telegraph rang, "stand by," "slow," "stop," "full astern," "stop." I heard the rattle of the anchor chain in the hawser pipe and knew the "mud hook" was down and we were safe at anchor.

Ten minutes later I was standing under the ventilator when I heard a confusion of shouts on deck and the second mate shoved his head into the hood of the ventilator and shouted, "All hands on deck, we are being run into."

I thought he was kidding, and paid no attention; the next moment there was the sound as of a mighty explosion. I remember thinking it was the donkey boiler, and hoping it had taken the chief along with it, for he had treated me scandalously since I earned and got the twenty pounds from the captain. Then through the half-open starboard bunker door there gushed a great torrent of water; for a moment I was at a loss what to do. Just then the chief appeared at the head of the engine-room ladder. "Ye domd Yankee fule, whit way are ye staunin there like a stuck pig; can ye no pit th' dunky pumps on th' bilges?"

That assembled my wool-gathering wits; while I was busy with the bilges the cable was slipped and the ship was beached.

When we were safely on the bottom we went into the bunker and discovered a clean cut below the water line about three inches wide by four feet long. The carpenter cut us a lot of pine wedges and wrapping them in cotton waste we drove them into the breach, so that by the time they were all in and the cotton had had a chance to swell she did not leak a bucketful an hour.

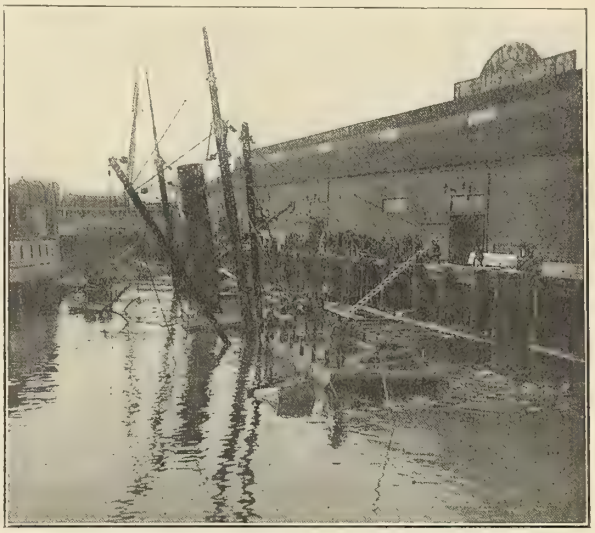
Next day we found that the *St. Asaph* had arrived at Gibraltar two days before we had; the boat whose lights I had seen was the *Excellent*. Her skipper was dodging around outside waiting for a pilot, and on seeing us go in he thought he would save pilotage and follow. But he was unacquainted with the treacherous nature of the bottom of Gibraltar harbor, which is a series of flat table lands with deep valleys in between.

A few minutes after we had cast anchor they had also cast anchor, evidently at the edge of one of these table-lands, and when the pull had come on the anchor (with the go astern order which is always given when coming to an anchorage), it had dragged into the valley, and there not being enough chain out for the anchor to catch, the vessel became unmanagable and drifted beam on to the *St. Asaph's* bow, tearing away her fore foot and rammed a hole in her own port side so large that she began to sink at once. She then drifted bows on to our starboard side and finished up by sinking. So she did not get past the capes after all.

We lay in Gibraltar for about ten days—it took the Spanish machinist that length of time to put on a 5-8-inch plate 8 inches wide by 5 feet long, with about 35 5-8-inch cap screws in it. We eventually discharged our cargo all right at Fresh Wharf, London, and then went to Wallsend shipway for repairs. But that's another story.

Sinking of the Steamship City of Topeka.

On the evening of September 11, the steamship *City of Topeka,* owned by the Pacific Coast Steamship Company, mysteriously sank at her dock at Seattle, Wash., while loading cargo destined for Alaska ports. The loading was being rushed in order that the vessel could sail the following day, and about $50,000 worth of miscellaneous cargo had been put aboard when it was suddenly discovered that the steamship was rapidly going down by the head. At the same time she took on a heavy list, and in alarm the stevedoring crew, the only persons aboard, promptly climbed on to the dock. The vessel continued to sink at a rapid rate, and within half an hour was lying at the bottom, with only the upper part of her smoke stack and masts above water.



STEAMSHIP CITY OF TOPEKA, SUNK AT HER DOCK.

At low tide next morning her decks were just awash. Divers were at once sent down to ascertain the cause of the accident, and to begin the work of removing the cargo, so that operations to raise the craft could be commenced at the earliest possible moment.

The cause of the vessel's sinking, if known, has not been divulged, although it is broadly hinted that an open port hole or broken dead light is responsible for the disaster. A coffer dam is in course of construction around the submerged vessel, and it is thought that she will be again floated inside of a few weeks. The damage to cargo and salvage operations will make the loss easily amount to $100,000. All work is being conducted with the utmost secrecy, and a high fence has been built around the scene of operations to prevent spectators seeing what is going on. The vessel is iron hull, 746 net tonnage. She was built at Chester, Pa., in 1884.

Annual Meeting of the Society of Naval Architects and Marine Engineers.

The twelfth annual meeting of the Society of Naval Architects and Marine Engineers will be held on Thursday and Friday, November 17-18, 1904, at 12 West 31st street, New York, N. Y. The sessions will be held morning and afternoon of each day, and on Friday

evening, the 18th, the annual banquet will be held. A list of papers to be read is as follows:

1. Simple Methods in War Ship Designs a Necessity. By George W. Dickie, member of council.
2. The Semi-Globular Naval Battery. By Anson Phelps Stokes, associate.
3. The Sea-Going Battleship. By Commander William Hovgaard, Royal Danish Navy, member.
4. Some Further Notes on the Performance of the Torpedo Boats of the United States Navy at Sea. By Lieut.-Commander L. H. Chandler, U. S. Navy.
5. The Position of the Center of Lateral Resistance. By L. E. Bertin, member.
6. Some Recent Experiments at the United States Model Basin. By Naval Constructor D. W. Taylor, U. S. Navy, member of council.
7. Coaling of War Ships at Sea—Recent Developments. By Spencer Miller, member.
8. Time Allowance for Steam Yacht Races. By Ex-Engineer-in-Chief George W. Melville, U. S. Navy, Vice-President.
9. On the Rules of Lloyd's Register for Building Yachts to Class. By George Stanbury, member.
10. The Shipping and Shipbuilding of Puget Sound. By Frank W. Hibbs, member.
11. Maintenance of Machinery in Merchant Ships. By Robert Haig, member.
12. High Speed Gasoline Launches. By Clinton H. Crane, associate.
13. Speed and Power of Recent Motor Boats. By Alpheus A. Packard, member.
14. Recent Launching Practice of the Atlantic Coast. By Assistant Naval Constructor R. H. M. Robinson, U. S. Navy, member.
15. Recent Launching Practice of the Pacific Coast. By Everett P. Lesley, Esq.

MARINE ENGINEERING DATA CARD. NOVEMBER, 1904.

NAME—Aki-Maru. NATIONALITY—Japanese. TYPE—Ocean passenger and freight steamship.

LAUNCHED—1903. BUILDER—Mitsu Bishi Dockyard and Engine Works. OWNER—Nippon Yusen Kaisha.

Length between perps	445 ft. 4 ins.	Stroke	48 ins.
Breadth, molded	49 " 6 "	Valves, piston on H. P.	slide on I. P. and L. P.
Depth, molded	30 " 5 "		
Load draft	25 " 0 "	I. H. P., on trial	5,398
Displacement	11,780 tons	Speed, " "	15.36 knots
Dead weight capacity	6,745 "	**Boilers:**	two single-end; two double-end
Tonnage, net	3,995	Length	10 ft. 0 ins.; 17 ft. 6 ins.
" gross	6,444	Diameter	13 " 9 "
Water ballast	1,797 tons	Pressure	200 lbs.
Coal, net, bunkers	514 "	Number of furnaces	18
" in reserve bunkers	966 "	G. S.	325 sq. ft.
Cubic capacity	370,000 cu. ft.	H. S.	9 975 " "
Stores	11,700 " "	H. S. ÷ G. S.	30.7
Engines:	twin screw, triple	H. S. ÷ I. H. P.	1 85
Cylinder diams	20, 33 1-2, 56 ins.	I. H. P. ÷ G. S.	16.6

Proposals for Warships.

The Navy Department has issued two circulars describing the proposed 16,000-ton battleship *New Hampshire,* and the two 14,500-ton armored cruisers *North Carolina* and *Montana,* which were authorized by the last congress. Plans and specifications will be furnished of the prospective boats on applying to the Department, and bids will be opened by the Department at noon, December 15, 1904. The ships are to be practically duplicates of the latest vessels of those classes now under construction, viz.: the battleship *Connecticut* and the armored cruiser *Tennessee.* The price of each ship, exclusive of armor and armament, is limited to $4,400,000. The maximum time allowed for completion will be 42 months, with a penalty of $300 a day for the first month delay in completion and $600 a day thereafter until completion.

The battleship must, on a four-hour trial, maintain an average speed of 18 knots. She will also be subjected to progressive speed trials and an endurance trial of 24 consecutive hours at two-thirds power. Her general dimensions are to be as follows:

Length on load water line, 450 feet.

Breadth, extreme, at load water line, 76 feet 10 inches.

Displacement on trial, not more than 16,000 tons.

Mean draft to bottom of keel at trial displacement not to exceed 24 feet 6 inches.

Total coal bunker capacity, about 2,350 tons.

Coal carried on trial, 900 tons.

Feed water on trial, 66 tons.

Ammunition, 405 tons.

Guns, mounts, magazine equipments, etc., 1,063 tons.

Armor, armor backing splinter bulkheads, etc., 3,935 tons.

Steam engineering, complete, 1,500 tons.

The armament is as follows: Main battery, four 12-inch breech loading rifles, eight 8-inch breech loading rifles, twelve 7-inch breech loading rifles, four submerged torpedo tubes. Secondary battery, twenty 3-inch, 14-pounder, rapid fire guns; twelve 3-pounder, semi-automatic guns; four 1-pounder, semi-automatic guns; two 3-inch field pieces; two machine guns, .30 caliber; two automatic guns, .30 caliber.

It will be noted that the above dimensions and armament are identical with the ships of the *Connecticut's* class; the armor is also much the same. The 12-inch guns to be mounted in two turrets, one forward and one aft, the 8-inch guns in four turrets, two on each beam at the ends of the superstructure, and the 7-inch guns on pedestal mounts on the gun deck behind 7-inch armor and separated by splinter bulkheads.

The hull is to be protected on the water line by a complete belt of armor 9 feet 3 inches wide, with a uniform thickness of 9 inches for about 285 feet amidships, gradually decreasing to 4 inches at the stem and stern. The side and end casemate armor is to be 7 inches thick. The 12-inch turrets are to have a front plate of 12 inches and the remaineder 8 inches thick, the barbettes are 11 inches. The 8-inch turret front plate will be 6 1-2 inches and the rear plate 6 inches, and the barbettes with 6 inches front and 4 inches in the rear. The conning tower will be 9 inches thick with 6-inch armor tube extending to protective deck. The

protective deck extends from stem to stern 2 1-2 inches on the slopes and from 1 to 2 inches on the flat.

The general dimensions of the armored cruisers are to be as follows:

Length on load water line, 502 feet.

Breadth, extreme, at load water line, 72 feet 10 1-2 ins.

Displacement on trial, not more than 14,500 tons.

Mean draft to bottom of keel at trial displacement not to exceed 25 feet.

Total coal bunker capacity, about 2,000 tons.

Coal carried on trial, 900 tons.

Feed water on trial, 66 tons.

Guns, mounts, magazine equipment, etc., 626 tons.

Ammunition, 2-3 cruising supply, 338 tons.

Steam engineering, complete, with water in boilers, 2,060 tons.

Total protection, 2,541 tons.

The armament consists of the following guns: Main battery, four 10-inch breech loading rifles; sixteen 6-inch breech loading rifles; twenty-two 3-inch rapid fire guns, four submerged torpedo tubes. Secondary battery, twelve 3-pounder semi-automatic rapid fire guns; four 1-pounder semi-automatic guns; two .30 caliber machine guns; two .30 caliber automatic guns; two 3-inch field guns.

These ships are to make on a four-hour trial an average speed of 22 knots and are also to be subject to progressive speed and endurance trials.

Heavy penalties are laid upon the contractors if the vessels fall below contract speed.

Launch of Battleship Nebraska.

An unusual incident connected with the launch of a ship took place when the battleship *Nebraska,* built at Moran Bros. Company, Seattle, Wash., unexpectedly slid down the ways before the appointed hour. The time set for the launch was 2:13 o'clock, October 7. Most of the wedges had been driven and the shores removed at 2 o'clock; two minutes later there was a splintering of the wooden trigger which held the cradle, and the vessel gradually gathered headway and slid down the ways. Fortunately there was not an accident of any kind to mar the occasion; the sponsor of the ship showed presence of mind to break the christening bottle of champagne upon the bows before the ship got away. As the ship began to move, files of sailors and sodiers on either side of the ways were brought to present arms, and thus stood until the vessel gracefully floated on the water of Puget sound.

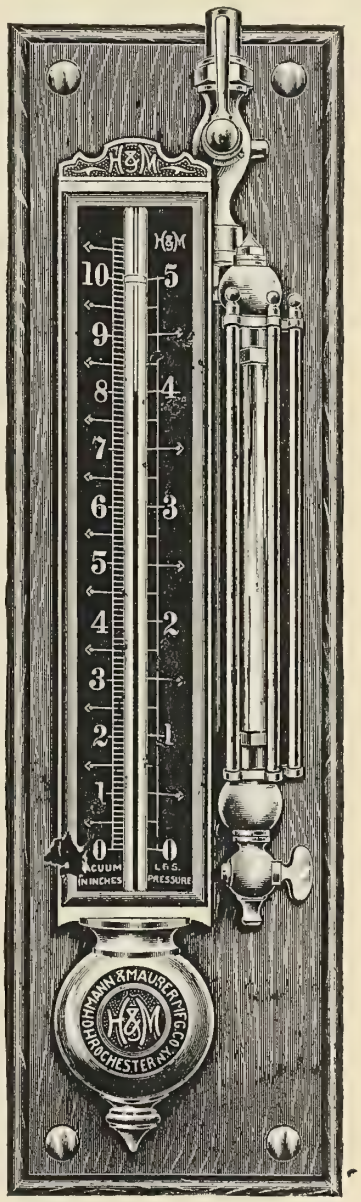
The *Nebraska* is of the *Georgia* class, and also a sister ship to the *Virginia,* described in Marine Engineering of June, 1904, and to the *New Jersey* and *Rhode Island.*

New Supervising Inspector.—The president has appointed Ira Harris to succeed R. S. Rodie as supervising inspector of the second district of the steamboat inspection service. Mr. Harris is a graduate of the Naval Academy and resigned as lieutenant commander after fifteen years to enter private business. At the outbreak of the Spanish war Mr. Harris again entered the navy and at the close of the war was appointed supervising engineer inspector of the army transport service, and after that was appointed to a post in the emigration service.

ENGINEERING SPECIALTIES.

Mercury Column Gauges.

As a result of the failure of dial thermometers to give satisfactory results on shipboard, the navy department has ordered the builders of war vessels to substitute mercurial thermometers of the Hohman & Maurer type. These makers have also recently perfected a device for determining the absolute pressure

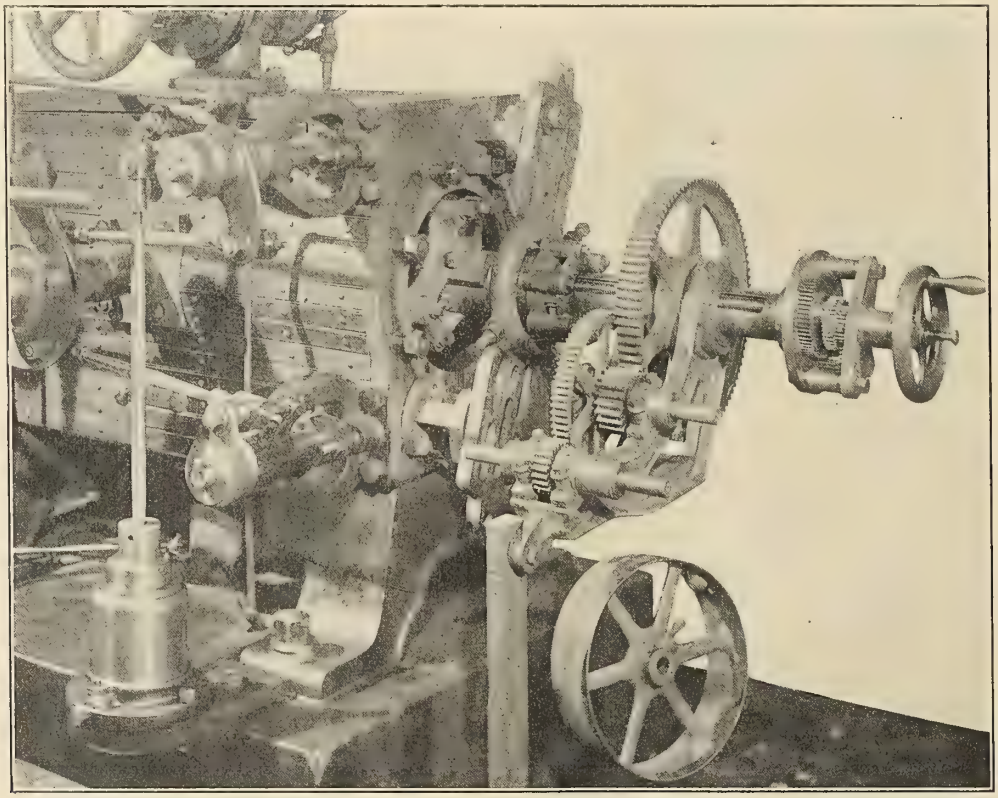


MERCURY GAUGE FOR THE ABSOLUTE PRESSURE IN A VACUUM.

of air remaining in a vacuum apparatus, such as a condenser, which indicates actual pressure above the actual vacuum. It is, therefore, read without reference to barometric reading or change of level in cistern.

In the illustration, the gauge glass at the right is a part of the condenser, which is not shown, and guards against possible errors due to water accumulating on the surface of the mercury. This is safely housed in

a wide cylinder behind the scale case, and cannot spill in transportation or handling, nor oxidize in a glass tube, since it does not come in contact with the air. Altogether, it is a most compact instrument mounted on a hard wood panel. The scale case is of bronze, highly polished and has an opening of 12 inches with the scale placed in the open V, a heavy plate glass is held with a metal frame. The scale is double and reads in vacuum in inches of water on one side and pounds per square inch on the other side.



PORTABLE BORING BAR, SUITABLE FOR CYLINDER OR STERN TUBE USE.

Portable Boring Bar.

The boring bar here illustrated is designed especially for use in places difficult of access, such as propeller shaft bearings. These bars are made from 2 1-2 up to 12 inches diameter, of stiff grade crucible steel, and are driven by a train of gears so arranged that the larger or master wheel can be quickly detached, thus allowing it to be put in places cramped for space, and makes it lighter to handle. The gear can be placed between frames and the bar run through. The cutter head holding the tools, which are of size suitable for the work, is moved along the bar by a steel screw having a strong well-designed thrust bearing. The rate of feed per revolution is regulated by trains of gearing in a casing and with a slip pin arrangement whereby any train of gears can be used to give light or heavy feed, as the material requires. The same bars are used and adapted for attaching to cylinders or other class of work. When supplied for boring stern post bearings the makers furnish an extra bearing, and sometimes the cutter heads are made in two pieces, which are fitted and bolted together. This latter arrangement is for use when boring through a bulkhead or other obstruction which prevents moving the machine along. Thus it is not necessary to shift the bar as set. The equipment for general shipyard purposes includes an extra long bar for other than cylinder work; all other parts are interchangeable. The manufacturers, H. B. Underwood & Company, 1025 Hamilton street, Philadelphia, Pa., have had many years' experience in designing tools for this service, and the result is that with their bar it is claimed that work can be done more rapidly than with other tools. A number of these boring outfits and other special tools have been shipped to foreign customers, as well as the United States navy yards and many shipbuilding companies.

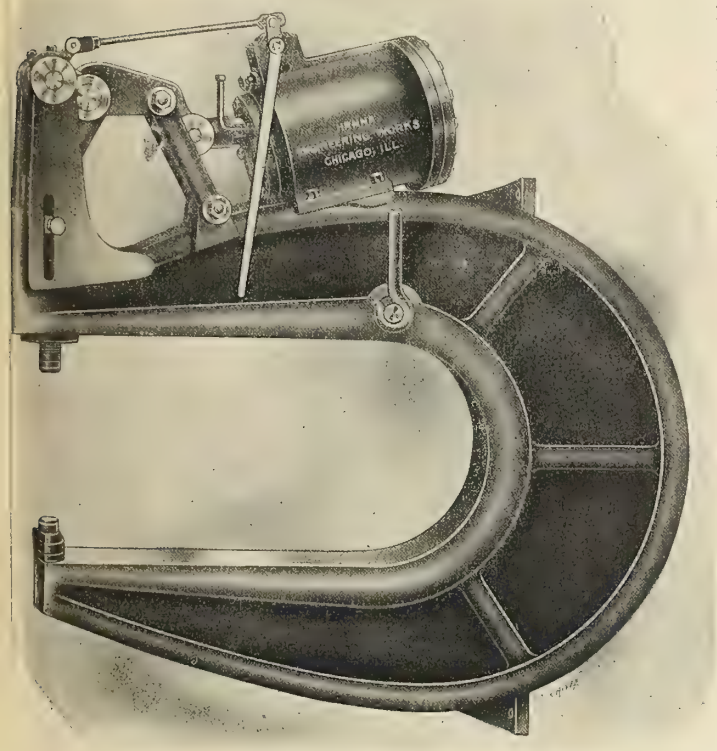
Pneumatic Compression Yoke Riveter.

In order to appreciate the characteristics of the Hanna compression yoke riveter here illustrated, it is necessary to have in mind the four general classes of compression riveting machines which are at present on the market.

The hydraulic machine, in which the riveting die is driven forward by and directly connected to a ram or piston, the operating fluid is under a high pressure of from 1,500 to 1,000 pounds per square inch. While this machine possesses the great advantage that the rivet is under maximum pressure for the full stroke,

the disadvantage and expense of maintaining the hydraulic packing and piping connections, as well as the line of high pressure piping, greatly restricts its use.

In the hydraulic-pneumatic machine, the riveting die is directly connected to an hydraulic plunger, which is operated by both a high and low pressure, a high pressure being obtained by the machine through an intensifying arrangement acted upon by pneumatic pressure. In this machine the same trouble is experienced with hydraulic packing, but the service pipe is not under the great pressure: it also possesses the advantages of the plain hydraulic machine.



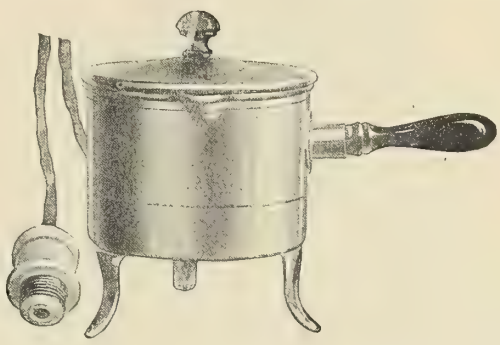
PNEUMATIC COMPRESSION YOKE RIVETER.

In the pneumatic machine the riveting die is attached to one end of the crank lever and the pneumatic piston to the other. This is satisfactory for ordinary structural work where but 50 tons pressure is necessary.

The fourth type is the pneumatic toggle joint machine, where the riveting die is attached to the end of one member of the toggle joint; the other member is joined to the main frame, and the piston rod of the pneumatic piston is attached to the center joint of the toggle. This arrangement gives a most desirable movement to the die, in that the relative movement of the die to the piston is greatest at the first of the stroke and least at the end of the stroke when the two are moving almost at right angles, but it is defective in that there is but one point at which the desired pressure is reached and this point is so near the end of the stroke where the leverage is changing so rapidly, that if the desired pressure is reached and the toggles are 1-2 inch from a straight line the expansion of the air in the cylinder will carry the toggles forward to the stop; thus if the rivets are not of exactly uniform length the die will require separate adjustment for each rivet.

The Hanna pneumatic compression yoke riveter, manufactured by the Hanna Engineering Works, 82 Elston avenue, Chicago, Ill., consists of a combination of toggles and levels to give the large opening of the toggle joint movement, with its gradually increasing pressure up to the desired maximum pressure, and then a simple lever movement throughout a considerable space under uniform maximum pressure. The space over which the uniform maximum pressure is available assures that the given pressure is applied to the rivet even if such rivets are not of uniform length, and the machine once adjusted for a certain length of rivet and thickness of plate requires no further adjustment.

These machines are built in several sizes. That here illustrated has a 29-inch reach, a 24-inch gape, and is provided with pneumatic cut-off. It will drive structural rivets up to 1 1-4 inches 42 inches from the edge of a girder with a cover plate 21 inches wide and is of 75 tons capacity. It may be operated by either air or steam.



SMALL, CONVENIENT ELECTRIC HEATER.

The Simplex Heater.

How often a little boiling water is wanted every day, and almost everywhere, has been appreciated by the Simplex Electric Heating Company, Cambridgeport, Mass., which has placed on the market a very convenient article that seems to meet the demand in the office, the hotel, on board ship, or wherever a lighting circuit is available. As shown in the illustration it is in the form of a cup with a plug and cord.

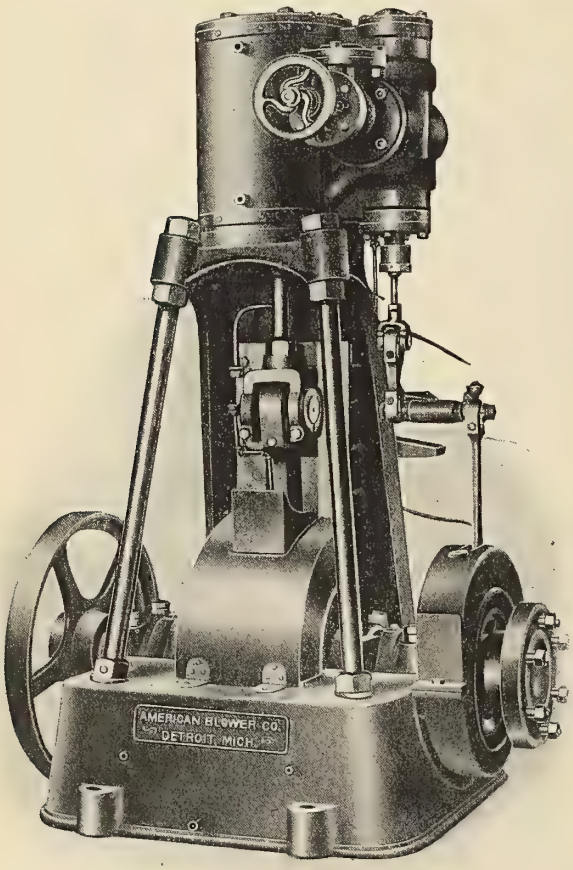
The illustration does not convey an adequate idea of the value and convenience of this device. A special feature is that it is so quick to boil that many a cup of tea will find its way to the busy office man who could not spare the time for it if compelled to bother with sooty gas and slower methods. It will boil a cup of water in three minutes, or a full pint in six, from the time of turning on the current.

For shaving, for some warm water to wash one's hands, or for any sudden demand, it is just what is required. Being bright, clean, and thoroughly sanitary, it can be used directly in a sick room.

It is ideal, for with all the above advantages its high efficiency makes the cost of operating slight, because with current at one-cent per lamp hour a pint of water can be boiled for less than 1-3 of a cent. Certainly nothing more can be desired.

Vertical High Speed Engine.

The American Blower Company, Detroit, Mich., has brought out a new line of vertical single cylinder engines of the marine type to meet the requirements where continuous operation is absolutely necessary. The engine here illustrated is identified as Type B, direct connected. It is mounted on a solid casting of box form, dished to receive the drippings and with suitable drain. The main bearings and brasses have ample surface and are lined with best quality of babbitt. The engine is



NEW HIGH-SPEED ENGINE FOR DIRECT-CONNECTED SERVICE.

mounted on a frame with cast iron back column and steel rods at front. The crosshead guides are fastened to the back column and are provided with screw adjustments. The cylinder and steam chest are cast in one piece and bolted to the top frame. The valve is of the double ported balanced type, and the piston is hollow, provided with snap packing rings. The crank shaft is a solid steel forging, with counterweight to reduce vibration; the eccentric rod and connecting rod are also forged steel, the latter with forked ends provided with brasses and suitable adjustment to take up wear. There is a slipper crosshead with wearing surfaces babbitted.

Lubrication to the main journals is supplied by ring oilers and that to the rest of the engine is fitted to give perfect and continuous lubrication. The engine as a whole is highly finished, all exposed metal parts being polished and carefully dressed down, filled and painted. In the automatic type the Rites-Carpenter fly wheel governor is furnished.

Automatic Center Punch.

An automatic center punch entirely new in design, containing features that make it much more convenient and accurate for laying out work to be machined or drilled than the ordinary center punch and hammer, has recently been placed on the market by the Brown & Sharpe Manufacturing Company, Providence, R. I.

In designing this tool every care has been taken to combine lightness and simplicity with durability. The various parts are proportioned to withstand the most severe usage to which a tool of this character should be subjected. All parts are of steel proportioned and adjusted to avoid libability of getting out of order. The parts most subject to wear are carefully hardened

AN AUTOMATIC CENTER PUNCH.

The tool is self-contained, the striking mechanism being enclosed in the knurled handle, which is of such a size and form as to be conveniently held in the hand. It is about 5 1-4 inches long and 5-8 inch diameter.

When following a line or establishing a point by the intersection of lines, one hand can be free to guide the point or hold the magnifying glass, and, after the point is located, it is not apt to slip and lose the setting, as just a downward pressure of the handle releases the striking block and makes the impression. Another advantage appreciated by mechanics is that the punch marks are all of uniform depth, and, therefore, more easily and accurately followed than when of varying depths.

QUERIES AND ANSWERS.

All reasonable questions concerning marine engineering received from and signed by subscribers will be answered by the editor in this column. All communications must bear the name and address of the writer.

Q. 252.—Will you please give rule for setting piston valves of a marine compound engine with Joy valve gear.

Also tell me how to find the dead centers of a marine compound engine. READER.

A.—To fully describe the method of setting the Joy valve gear would take more space than we can use in these columns, and therefore we would advise you to refer to some of the many books on this subject, preferably Durand's *Practical Marine Engineering*. To set a Joy gear embodies no more features than that of the ordinary gear, as the valve gear has already been designed and built, and the lengths of the different connecting arms established. The principal difficulty is to balance up each end, which can be done by lengthening or shortening of valve stem. In the piston valve the engine must be slowly turned over and the location of the valve must be determined by sighting through peep holes in the shell of the valve chest. It is of course impossible to get all the features of both ends such as admission, cut-off, exhaust, opening and closing the same. The valve should be so adjusted that each point on top and bottom balances fairly closely without distorting the other points. The setting of the valve may be most advantageously done by the use of indicator cards. We wish it were possible to fully answer your question, but to do so would open up a very broad topic.

There are several ways of marking the dead centers on an engine: one by sighting with the eye along a bob weight swung from the center of a crosshead pin along the connecting rod. Another good method for permanent use is by marking on the crosshead slide and guide and on the main shaft adjacent to a journal as follows:

Turn the engine over until the crank is almost on a center, say to such a point that the crosshead has but one inch more to slide to the end of the stroke. Draw a horizontal line across the crosshead and the guide, also mark the shaft at a convenient place adjoining a journal, and mark the journal opposite the point. Now, slowly turn the engine over the center until the marks on crosshead and guide again come opposite each other; mark on the journal the point opposite which the shaft mark now is. Measure off the distance between the two marks on the journal, divide in two and mark this half distance. Now by bringing the mark on the shaft opposite this new journal point the engine will be brought on a dead center.

Q. 253.—Kindly advise through your MARINE ENGINEERING, of the next issue, the limitable size of a steam pleasure craft, for a person to own and guide through the waters of New York—the person not wishing to go through a nautical examination.

A. G.

A.—The United States steamboat inspectors issue a special engineer's license for pleasure steam vessels up to 10 tons. For larger vessels a regular license is required. Full information may be obtained by applying to the U. S. Steamboat Inspection Service, Washington, D. C., or to your nearest local inspector.

If "G. W. P." of Marysville, Cal., will write to us, we will answer his question.

Q. 255.—Will you kindly let me know if I am correct in the way I have worked out the following, and, if not, point out my errors?

As I understand it, the moment of inertia of a rectangle is $\frac{L\,B^3}{12}$, and if a vessel had a rectangular water plane at the load line, then $\frac{L\,B^3}{12}$ divided by the volume of displacement in cubic feet would give the distance in feet and fractions of a foot from the center of buoyancy to the transverse metacenter.

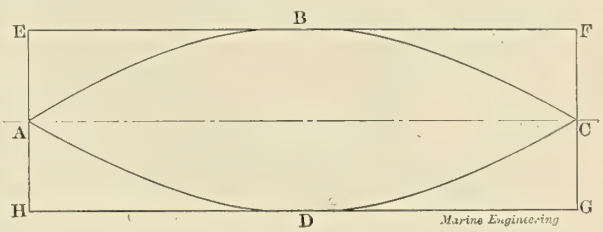
Now, if you know positively the exact full area of your load water plane, can you not express yourself as follows:

$\frac{A\,B^2}{12}$ = moment of inertia of L. W. plane, where A = the full area, and then by dividing this answer by the cubic foot of displacement obtain the height of the transverse metacenter above the C. B.

I have a lunch whose total load water plane area is 52.94 square feet, and whose greatest water line beam is 3.62 feet. Therefore, can I say $\frac{L\,B^3}{12} = \frac{A\,B^2}{12} = \frac{52.94 \times 3.62^2}{12}$, and divide my answer by 33, which is the displacement in cubic feet, and obtain the desired distance between C. B. and metacenter? J. R. H.

A.—You are incorrect in the assumption that you can use for your actual water plane a formula which is correct only for a rectangle.

It is perfectly true that $A \times B^2 \div 12$ will give the moment of inertia of a rectangle about an axis through the middle, and running at right angles to B. This would therefore be a correct formula for a scow or float with rectangular water plane. When you depart from the rectangle, however, and approach the typical form of the water plane area of a ship, such formulæ no longer applies. As to why it does not apply may be seen without going into the mathematical discussion by the following considerations:



The moment of inertia of an area about an axis may be defined as the sum of an indefinitely large number of small elements, each one of which is the product of its area by the square of its distance from the axis. Counting each element of the same area, therefore, it follows that the moment of inertia will depend on the total area and on the *location* of the elements as affecting the value of the square of the distance from the axis. Now, compare the area A, B, C, D, which represents your water plane, with E, F, G, H, which represents a rectangle, which would just surround it. Then your proposition is to take the area A, B, C, D, and multiply it by 1-12 the square of F, G, and call the result the moment of inertia of A, B, C, D. Now, recurring to the definition of the moment of inertia, it may be seen that it really represents the product of the total area by an average or mean square of the distances of its elements from the axis. Now, it is this mean square which in the case of the rectangle is represented by 1-12 the square of the breadth. But it may be seen that the mean square for the rectangle will be greater than that for the water plane area by reason of the influence of the corner parts

A E B, B F C, etc. These lying as they do would make the mean square for the rectangle greater than that for the water plane area, and therefore in using $P^2 \div 12$ for the mean square of A, B, C, D, a value too large would be employed, and a value for the moment of inertia would result in excess of the true value.

Knowing your water plane area and the dimensions, you may, however, find the moment of inertia quite closely by the following approximate formula:

$$I = \frac{B^2 A}{12}\left(1.2\,\frac{A}{BL} - .1\right)$$

Where A = area of water plane,
B = breadth " "
L = length " "

In your case you do not state the length, but if for illustration it is taken at 20 feet then we shall have as follows:

$$\frac{A}{BL} = \frac{52.94}{3.62 \times 20} = .731.$$

$$1.2 \times .731 - .1 = .777.$$

$$I = \frac{3.62^2 \times 52.94 \times .777}{12} = 45.25.$$

and $45.25 \div 33 = 1.37$ feet = distance of metacenter above center of buoyancy.

Q. 258.—Please answer in your magazine why boilers on western river steamboats (two-flue boilers) are made of so many small sheets, while Scotch boilers are made of one or two large sheets, for the same pressure. C. A. G.

A.—As far as we are aware the reason that the boilers on western river steamboats are made of smaller sized plates is that said plates are easier to handle in the shop than plates of greater thickness and size. The western river type of boiler is a development to suit the conditions. It would not do for steamship service, as it takes up too much room. As its diameter is small the plates are correspondingly lighter than those of Scotch boilers of the same type.

Q. 259.—Please inform me how to equalize the horse power of a triple-expansion engine, assuming that the intermediate was way above the H. P. and L. P. Also, how could I determine the consumption of water by a triple-expansion engine per hour approximately? Oiler.

As you have not stated the size of engine, our answer must be in general remarks. In the first place the ratio of the size of cylinders may be at fault, for in a multiple expansion engine the areas of the cylinders must bear certain relations to each other in order to properly distribute the power among the cylinders. This ratio depends upon the boiler pressure and is about as follows:

Boiler Press	120	140	160
Area L. P. / Area H. P.	5.4	6.2	7.0
Area M. P. / Area H. P.	2.11	2.25	2.4

In your engine we assume the cylinders follow closely these ratios, otherwise they are out of proportion and it will be more difficult to equalize the power and a change may be necessary in the valve. With correctly proportioned cylinders and valves the adjustment may usually be made by linking in or out. You say nothing about the valves, so we also assume these to be of correct design.

Now, to place more power in the high pressure cylinder, link out the intermediate to give the latest cutoff. This will tend to reduce the receiver pressure, which it is to be remembered is the back pressure of the high pressure cylinder, and the admission of the intermediate. Thus there is a wider range of effective pressures in the high and a narrower range in the intermediate, the resulting effect being an increase of power in the former and a decrease of power in the latter cylinder. This effect may be readily seen on a set of indicator cards.

Similarly to place more power in the low, link *in* on that valve. The result may not be so noticeable, but generally it will have the desired effect. If this simple procedure does not distribute the power correctly, an examination of the valves, amount of lead, steam and exhaust lap, travel, etc., will doubtless reveal the point of trouble.

A rough approximation of the water rate of an engine, single or multiple expansion, is determined by measuring on the indicator card the volume, including clearance, of any one of the cylinders, preferably the high pressure cylinder *up to the point of* cut-off, which is the volume of steam used each stroke. This point is marked *a* on the accompanying indicator card, which is that taken from the head end of the high pressure cylinder on the trial trip of the revenue cutter *Mohawk,* described in the July issue of Marine Engineering. The volume of steam to this point is indicated by the shaded rectangle *a, a', a'', a'''*, and the pressure at *a* is measured vertically from the atmospheric line.

On the return stroke there is always left a certain amount of steam in the cylinder and clearance, as shown by the compression line. This amount must be deducted to obtain the net weight of steam supplied to the engine. The point *b* on the card is taken as the point at the end of compression, and the area *b, b', a''* and *b''* represents the volume of steam left in the cylinder at a pressure measured by the line *b', b*. For simplicity's sake we will assume that the steam is saturated at points *a* and *b*. Following are some of the dimensions and data of the engine and trial.

Cylinders 25, 37 1-2, 56 1-4 inches by 30 inches
Revolutions per minute.....154
Indicated horse power.....2,604
From the card the following quantities are found:
Clearance, per cent. of stroke assumed.....14.7
Point of cut-off, per cent. of stroke.....80.3
Point of cut-off, per cent. of stroke from clearance line 95.0
Cut-off, pressure at *a*, pounds.....110
Compression, per cent. of stroke.....16
Compression, pressure at *b*, pounds.....107.2
Area of cylinder, square inches.....490.9
From the above we calculate the following:

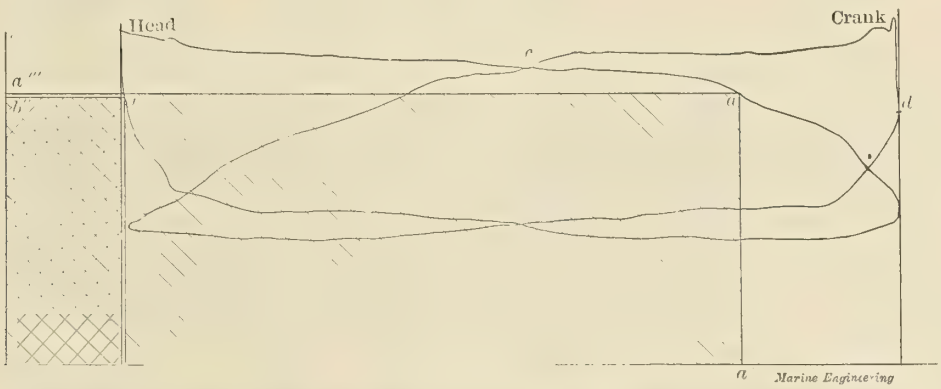
$$\frac{490.9 \times 30'' \times .95}{1728} = 8.10 \text{ cubic feet of steam per stroke.}$$

$$\frac{490.9 \times 30 \times .16}{1728} = .136 \text{ cubic feet of steam left in cylinder.}$$

From the tables of saturated steam it is found that at the cut-off and compression pressures, one cubic foot of saturated steam weighs .2833 pounds and .2769 pounds respectively. Multiplying the cubic feet by the respective weights per cubic foot, we have 2.290 pounds and .387 pounds respectively, and deducting the latter from the former the net amount of steam used per stroke is 1.903 pounds.

draft is used, the consumption being usually higher in the latter case.

The card factor is less in an early cut-off than with the late cut-off. This factor is used to account for clearance, compression, radiation, condensation, etc., between the theoretical condition of adiabatic expression and the practical results. Now these disturbing elements are practically the same whether the engine is running full or partial power; therefore, their ratio to the power developed is larger when running at partial power.



CALCULATING STEAM CONSUMPTION FROM INDICATOR CARD: ATMOSPHERIC LINE $a'a''$, CLEARANCE LINE $a''a'''$

A similar operation should be followed for determining the steam in the crank end of cylinder, but for simplicity's sake we will assume it to be as in the head end as above. Therefore, the number of pounds per hour per I. H. P. is

$$\frac{1.903 \text{ lbs.} \times 154 \times 2 \text{ strokes} \times 60 \text{ min.}}{2604 \text{ I. H. P.}} = 13.5 \text{ lbs.}$$

This is probably too little, as we have not allowed for moisture in the steam. It suffices, however to illustrate the method which, at the best, is approximate. The only accurate method is to weigh the condensed steam.

Q. 261.—Kindly answer in your Q. & A. column, in November issue if convenient, the following questions:

1. What would be a fair average of consumption of steam in pounds per I. H. P. per hour of a set of triple-expansion engines, the ratio of cylinders being 1:2.28:6.25; boiler pressure being 150 pounds?

2. What would be a fair average consumption of coal per I. H. P. per hour in same set of engines, the cut-off in H. P. being about 3-4 stroke, the ratio of expansion about 9, and coal containing 10 per cent. of ash?

3. In an early cut-off would the card factor be higher than in a late cut-off? Kindly compare cut-off of 1-2 and 3-4 stroke for example. W. G.

A.—In some recorded tests of stationary triple expansion engines the water rate has been as low as 11 pounds per hour; but for usual good practice, 15 pounds may be considered an average figure. The coal consumed per I. H. P. depends upon the efficiency of the boilers. In the very best practice in marine work, where all the refinements and requirements known to engineering are used, a record of one pound of coal per I. H. P. has been made. For large size transatlantic ships a rate of 1.3 to 1.6 is the usual figure. The amount of coal burned will also depend upon the quality—that is, the number of heat units per pound of coal; also the method of firing and whether natural draft or forced

PERSONAL.

Joseph A. Barraja-Krauenfelder, formerly with the Fore River Shipbuilding Company, has accepted a position with the Holland Torpedo Boat Company, New Suffolk, L. I.

SELECTED MARINE PATENTS.

767,490. DIRIGIBLE TORPEDO. DAVID W. McCAUGHEY, CHICAGO, ILL. Twelve claims.

767,491. DIRIGIBLE TORPEDO. DAVID W. McCAUGHEY, CHICAGO, ILL. Three claims.

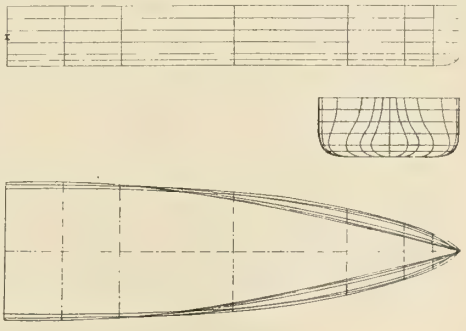
767,492. DIRIGIBLE TORPEDO. DAVID W. McCAUGHEY, CHICAGO, ILL. Twelve claims.

767,835. SUBMARINE SALVAGE VESSEL. JEAN M. RAOUL, TUNIS, AFRICA. Seven claims.

768,085. SAFETY KEEL FOR VESSELS. FRITZ O. STROMBORG, CLEVELAND, OHIO.

Claim.—1. A vessel and a safety keel on the bottom thereof consisting of two independent sections one above the other, a shaft on which said sections are mounted and mechanism for operating each section separately. One claim.

768,269. CONSTRUCTION OF SHIPS. HELEN CLARK, WASHINGTON, D. C.



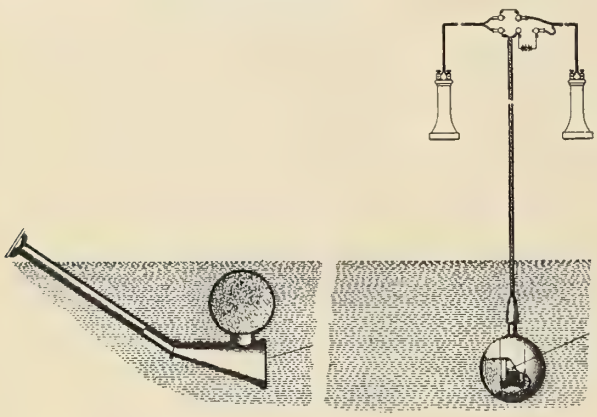
Claim.—1. A ship or vessel in which the angle of obliquity formed by the load water line, at the stem or cut water, with the longitudinal vertical middle plane of the vessel is smaller or more sharply pointed than the angle of obliquity formed by all the other water lines with the said longitudinal middle plane at points below the load water line. One claim.

768,567. SUBMARINE SIGNALING. ARTHUR J.

MUNDY, BOSTON, MASS., ASSIGNOR TO SUBMARINE SIGNAL COMPANY, WATERVILLE, ME.

Claim.—1. In an improved method of submarine signaling the transformation of the energy of the natural motion of the water into energy in the form of sound waves of a quality for submarine signaling, and the delivery of such sound waves to the water at a point below its surface. One claim.

768,572. SOUND TRANSMITTER AND RECEIVER. ARTHUR J. MUNDY, BOSTON, MASS.



Claim.—1. In a system of submarine telephony, a means for imparting to water at a point beneath its surface the vibrations of articulate speech, and a submerged electric transmitter and receiver adapted to receive said vibrations so imparted to the water and to electrically transmit them to a sound receiver. One claim.

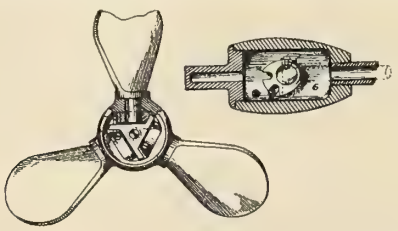
768,701. WAVE POWER APPARATUS. JOHN H. SMITH, LOS ANGELES, CAL. Fourteen claims.

769,100. SUBMARINE SIGNALING. JOSIAH B. MILLET, BOSTON, MASS.

Claim.—1. The method of communicating information as to the position or direction of a moving vessel to an observer removed from the vessel, consisting of the employment of the vessel itself, in connection with devices upon the vessel for producing sound vibrations or waves in the water surrounding the vessel, and the turning of the vessel for varying the degree of value of said sound waves or vibrations in a given direction. Three claims.

769,256. PROPELLER. HERRMAN ENGE, WEST BERKELEY, CAL.L

Claim.—A propeller comprising a hub, a series of propeller blades rotatably secured therein, a series of cranks located within the hub and connected to the shank of each blade, a pair of seats cut in each crank, a longitudinally movable rod working through



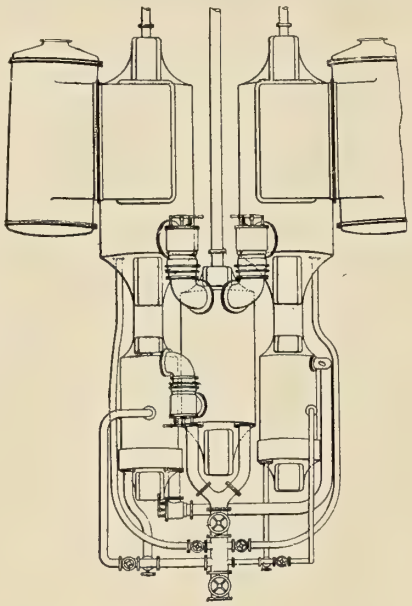
the hub, and a series of projecting studs carried by said rod, said studs engaging with the seats of the cranks so as to operate the said cranks to shift the blades during longitudinal movement of the rod. One claim.

769,272. MARINE STEAM TURBINE. CHARLES A. PARSONS, NEWCASTLE-ON-TYNE, ENGLAND.

Claim.—1. A system of turbines for propelling vessels consisting of a main turbine set for propelling the vessel with high economy at fast speeds, and an additional turbine set adapted to be put in series with the main turbine set when the vessel is to be propelled with high economy at cruising and low speeds, and automatic means for preventing a back flow of steam from the main turbine set to the additional turbine set when the former set is propelling the vessel at fast speed.

3. A system of turbines for propelling vessels, consisting of a main turbine set for propelling the vessel with high economy at fast speeds and an additional turbine set adapted to be put in series with the main turbine set for propelling the vessel with high economy at cruising and slow speeds, the main set comprising a high-pressure and two low-pressure turbines of large capacity mounted upon separate propeller shafts, and the additional set comprising a high-pressure turbine and an intermediate-pressure turbine mounted upon extensions of the propeller shafts.

5. A system of turbines for propelling vessels, consisting of a main turbine set for propelling the vessel with high economy at fast speeds and an additional turbine set for propelling the vessel with high economy at cruising and slow speeds, the main set comprising a plurality of turbines of large capacity and the additional set comprising a plurality of turbines of relatively small capacity, piping putting the cruising turbines in series with the main turbines, non-return valves in this piping between the turbines of both sets, valve-controlled live-steam inlets to each turbine, and additional live-steam inlets to each turbine, and additional live-steam inlets situated at intermedite positions in the lengths of the turbines of the cruising set. Five claims.

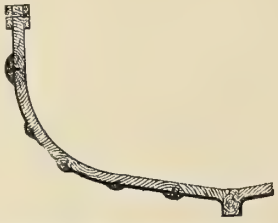


769,316. LIFE BOAT. ROBERT D. MAYO, GRAND RAPIDS, MICH. Three claims.

769,456. PROPELLING VESSELS. LUDWIG AUDRIETH, NEWARK, N. J.

Claim.—1. In a hydraulic propeller, the combination with the hull of a vessel having a duct extending longitudinally through the same, of an intermediate ejector nozzle in said duct, a chest in communication with said ejector nozzle, a receiver connected to said chest, a pump connected to said receiver, and tubes connected with openings in the hull and with said pump for supplying a continuous stream of water to said ejector nozzle. Four claims.

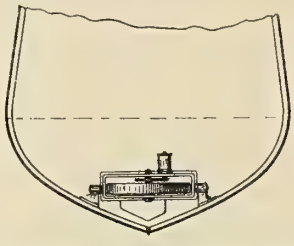
769,502. MARINE HULL. THOMAS H. SMITH, STURGEON BAY, WIS.



Claim.—1. A marine hull, comprising ribs, beads extending fore and aft along the other sides thereof, and metallic sheathing sections, one edge of each section lying under the bead adjacent thereto, and the other edge portions of the sheathing sections extending over the adjacent beads. Five claims.

769,621. SCREW PROPELLER. CAREY A. MANKER, PEARL, ILL. Five claims.

769,693. DEVICE FOR STEADYING SHIPS. THOMAS C. FORBES, MINNEAPOLIS, MINN.



Claim.—1. The combination with a vessel, of a fly-wheel support mounted to oscillate on an axis extending transversely of the axis of the vessel, a fly-wheel journaled in said oscillating support with its axis extending transversely of the axis of said support and of the longitudinal axis of the vessel, whereby the said fly-wheel is set to rotate in a plane extending in the general direction of the longitudinal axis of the vessel, and means for rotating said fly wheel. Six claims